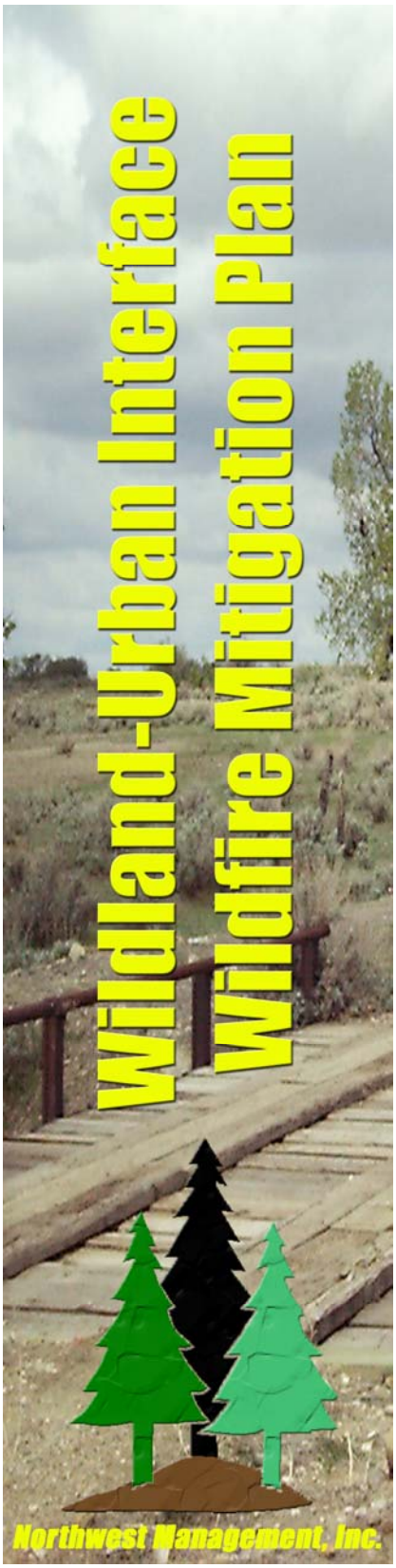

Petroleum County, Montana, Wildland-Urban Interface Wildfire Mitigation Plan

Main Document

September 7, 2004

Vision: *Institutionalize and promote a countywide wildfire hazard mitigation ethic through leadership, professionalism, and excellence, leading the way to a safe, sustainable Petroleum County.*

This plan was developed by the Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan Committee in cooperation with Northwest Management, Inc., P.O. Box 565, Helena, MT 59624, Phone: (406) 442-7555, Fax: (406) 495-9605, www.Consulting-Foresters.com

Acknowledgments

This Wildland-Urban Interface Wildfire Mitigation Plan represents the efforts and cooperation of a number of organizations and agencies, through the commitment of people working together to improve the preparedness for wildfire events while reducing factors of risk.

Petroleum County Commissioners,
the Employees of Petroleum County,
Winnett Volunteer Fire Department,
Local Businesses and
Citizens of Petroleum County

Snowy Mountain Development Corporation

USDI Bureau of Land Management

USDA Forest Service

Montana Disaster and Emergency Services

Federal Emergency Management Agency

Montana Department of Natural Resources and Conservation

Northwest Management, Inc.

To obtain copies of this plan contact:

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Chapter I: Overview of this Plan and its Development

1 Introduction

This Wildland-Urban Interface Wildland Fire Mitigation Plan for Petroleum County, Montana, is the result of analyses, professional cooperation and collaboration, assessments of wildfire risks and other factors considered with the intent to reduce the potential for wildfires to threaten people, structures, infrastructure, and unique ecosystems in Petroleum County, Montana. The planning team responsible for implementing this project was led by the Petroleum County Commissioners. Agencies and organizations that participated in the planning process included:

- USDI Bureau of Land Management
- USDA Forest Service
- USDI Fish and Wildlife Service
- Montana Department of Natural Resources and Conservation
- Snowy Mountain Development Corporation
- Winnett Volunteer Fire Department
- Northwest Management, Inc.

The Petroleum County Commissioners, working cooperatively with the Snowy Mountain Development Corporation, solicited competitive bids from companies to provide the service of leading the assessment and the writing of the **Petroleum County Wildland-Urban Interface Wildland Fire Mitigation Plan**. The Commissioners selected Northwest Management, Inc., to provide this service. Northwest Management, Inc., is a professional natural resources consulting firm located in Helena, Montana. Established in 1984 NMI provides natural resource management services across the USA. The Project Manager from Northwest Management, Inc. was Dr. William E. Schlosser, a professional forester and regional planner.

1.1 Goals and Guiding Principles

1.1.1 Federal Emergency Management Agency Philosophy

Effective November 1, 2004, a Local Hazard Mitigation Plan approved by the Federal Emergency Management Agency (FEMA) is required for Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation Program (PDM) eligibility. The HMGP and PDM program provide funding, through state emergency management agencies, to support local mitigation planning and projects to reduce potential disaster damages.

The new local hazard mitigation plan requirements for HMGP and PDM eligibility is based on the Disaster Mitigation Act of 2000, which amended the Stafford Disaster Relief Act to promote an integrated, cost effective approach to mitigation. Local hazard mitigation plans must meet the minimum requirements of the Stafford Act-Section 322, as outlined in the criteria contained in 44 CFR Part 201. The plan criteria covers the planning process, risk assessment, mitigation strategy, plan maintenance, and adoption requirements.

FEMA will only review a local hazard mitigation plan submitted through the appropriate State Hazard Mitigation Officer (SHMO). Draft versions of local hazard mitigation plans will not be reviewed by FEMA. FEMA will review the final version of a plan prior to local adoption to

determine if the plan meets the criteria, but FEMA will be unable to approve it prior to adoption. In Montana the SHMO is:

Disaster and Emergency Services
P.O. Box 4789 - 1900 Williams Street
Helena, Montana 59604-4789
Dan McGowen, 841-3911 - FAX: 841-3965

A FEMA designed plan will be evaluated on its adherence to a variety of criteria.

- Adoption by the Local Governing Body
- Multi-jurisdictional Plan Adoption
- Multi-jurisdictional Planning Participation
- Documentation of Planning Process
- Identifying Hazards
- Profiling Hazard Events
- Assessing Vulnerability: Identifying Assets
- Assessing Vulnerability: Estimating Potential Losses
- Assessing Vulnerability: Analyzing Development Trends
- Multi-Jurisdictional Risk Assessment
- Local Hazard Mitigation Goals
- Identification and Analysis of Mitigation Measures
- Implementation of Mitigation Measures
- Multi-Jurisdictional Mitigation Strategy
- Monitoring, Evaluating, and Updating the Plan
- Implementation Through Existing Programs
- Continued Public Involvement

1.1.2 Additional State and Federal Guidelines Adopted

The Wildland-Urban Interface Wildfire Mitigation Plan component of this All Hazards Mitigation Plan will include compatibility with FEMA requirements while also adhering to the guidelines proposed in the National Fire Plan and the Healthy Forests Restoration Act (2004). This Wildland-Urban Interface Wildland Fire Mitigation Plan has been prepared in compliance with:

- The National Fire Plan; A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy Implementation Plan–May 2002.
- Northern Rockies Coordinating Group
- Healthy Forests Restoration Act (2004)
- The Federal Emergency Management Agency's Region 10 guidelines for a Local Hazard Mitigation Plan as defined in 44 CFR parts 201 and 206, and as related to a fire mitigation plan chapter of a Natural Hazards Mitigation Plan.

"When implemented, the 10-Year Comprehensive Strategy will contribute to reducing the risks of wildfire to communities and the environment by building collaboration at all levels of government."
- The NFP 10-Year Comprehensive Strategy August 2001

The objective of combining these four complimentary guidelines is to facilitate an integrated wildland fire risk assessment, identify pre-hazard mitigation activities, and prioritize activities and efforts to achieve the protection of people, structures, the environment, and significant infrastructure in Petroleum County while facilitating new opportunities for pre-disaster mitigation funding and cooperation.

1.1.2.1 National Fire Plan

The goals of this Wildland-Urban Interface Fire Mitigation Plan include:

1. Improve Fire Prevention and Suppression
2. Reduce Hazardous Fuels
3. Restore Fire-Adapted Ecosystems
4. Promote Community Assistance

Its three guiding principles are:

1. Priority setting that emphasizes the protection of communities and other high-priority watersheds at-risk.
2. Collaboration among governments and broadly representative stakeholders
3. Accountability through performance measures and monitoring for results.

This Wildland-Urban Interface Fire Mitigation Plan fulfills the National Fire Plan's 10-Year Comprehensive Strategy. The projects and activities recommended under this plan are in addition to other Federal, state, and private / corporate forest and rangeland management activities. The implementation plan does not alter, diminish, or expand the existing jurisdiction, statutory and regulatory responsibilities and authorities or budget processes of participating Federal and State agencies.

By endorsing this implementation plan, all signed parties agree that reducing the threat of wildland fire to people, communities, and ecosystems will require:

- Firefighter and public safety continuing as the highest priority.
- A sustained, long-term and cost-effective investment of resources by all public and private parties, recognizing overall budget parameters affecting Federal, State, Tribal, and local governments.
- A unified effort to implement the collaborative framework called for in the Strategy in a manner that ensures timely decisions at each level.
- Accountability for measuring and monitoring performance and outcomes, and a commitment to factoring findings into future decision making activities.
- The achievement of national goals through action at the local level with particular attention on the unique needs of cross-boundary efforts and the importance of funding on-the-ground activities.
- Communities and individuals in the wildland-urban interface to initiate personal stewardship and volunteer actions that will reduce wildland fire risks.
- Management activities, both in the wildland-urban interface and in at-risk areas across the broader landscape.

- Active forestland and rangeland management, including thinning that produces commercial or pre-commercial products, biomass removal and utilization, prescribed fire and other fuels reduction tools to simultaneously meet long-term ecological, economic, and community objectives.

The National Fire Plan identifies a three-tiered organization structure including 1) the local level, 2) state/regional and tribal level, and 3) the national level. This plan adheres to the collaboration and outcomes consistent with a local level plan. Local level collaboration involves participants with direct responsibility for management decisions affecting public and/or private land and resources, fire protection responsibilities, or good working knowledge and interest in local resources. Participants in this planning process include Tribal representatives, local representatives from Federal and State agencies, local governments, landowners and other stakeholders, and community-based groups with a demonstrated commitment to achieving the strategy's four goals. Existing resource advisory committees, watershed councils, or other collaborative entities may serve to achieve coordination at this level. Local involvement, expected to be broadly representative, is a primary source of planning, project prioritization, and resource allocation and coordination at the local level. The role of the private citizen is not to be underestimated, as their input and contribution to all phases of risk assessments, mitigation activities, and project implementation is greatly facilitated by their involvement.

1.1.2.1.1 Montana's Endorsement of the National Fire Plan

In May 2002, Montana Governor Martz, as a member of the Western Governors' Association, helped developed the *10-Year Comprehensive Strategy* and an implementation plan, titled *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment*. With the Western Governors' Association endorsement of the Implementation plan, Montana adopted the national implementation plan as its own.

NFP funding to the states occurs under the community assistance point and is made available through the USFS state and private forestry programs. DNRC has responsibility for delivery of these programs on state-owned and private lands in Montana.

The DNRC NFP Program is implemented primarily within the Forestry Division's Fire and Aviation Management Bureau (FAMB) and Service Forestry Bureau (SFB). The National Fire Plan is delivered, wherever appropriate, through existing state and private forestry programs. These programs are:

- County Cooperative Fire Program (FAMB)
- State Fire Assistance Program (FAMB)
- Private Forestry Assistance Program (SFB)
- Stewardship Program (SFB)

The Volunteer and Rural Fire Assistance (VFA/RFA) Program provides assistance to county fire agencies for equipment, training, and fire prevention materials. Adding National Fire Plan funding resulted in a grant program with more money than ever before. Again in 2003, the Department of the Interior agencies (FWS, BLM & BIA) contributed their budgeted Rural Fire Assistance Program dollars to be combined with the Volunteer Fire Assistance funds granted by the USDA Forest Service. The total assistance available in Montana exceeded $1.1 million in 2003. DNRC and its partners were recognized with the Ben Franklin Award, given by the Forest Service annually to one state for excellence in delivering these programs.

1.1.2.2 Northern Rockies Coordinating Group

The Northern Rockies Coordination Group (NRCG) was established to provide an interagency approach to wildland fire management and all-risk support on all land ownerships within the States of Montana, North Dakota, northern Idaho, and a small portion of South Dakota and Wyoming. NRCG is made up of representatives from the Montana Firewarden's Association, Montana Disaster and Emergency Services Division, Montana Department of Natural Resources and Conservation, Idaho Department of Lands, North Dakota Forest Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs, Fish and Wildlife Service, Forest Service, Montana Fire Chief's Association, and Montana Sheriff's and Peace Officer's Association. The purpose of NRCG is to further interagency cooperation, communications, coordination, and to provide interagency fire management direction and all-risk support for the Northern Rockies Geographic Area.

1.1.2.2.1 County Wildland Fire Interagency Group

Each County within the state has been requested to write a Wildland Fire Mitigation Plan. These plans should contain at least the following five elements:

1) Documentation of the process used to develop the mitigation plan. How the plan was developed, who was involved and how the public was involved.
2) A risk assessment to identify vulnerabilities to wildfire in the wildland-urban interface (WUI).
3) A prioritized mitigation strategy that addresses each of the risks. Examples of these strategies could be: training for fire departments, public education, hazardous fuel treatments, equipment, communications, additional planning, new facilities, infrastructure improvements, code and/or ordinance revision, volunteer efforts, evacuation plans, etc.
4) A process for maintenance of the plan which will include monitoring and evaluation of mitigation activities
5) Documentation that the plan has been formally adopted by the involved agencies. Basically a signature page of all involved officials.

This five-element plan is an abbreviated version of the FEMA mitigation plan and will begin to meet the requirements for that plan. To develop these plans each county should bring together the following individuals, as appropriate for each county, to make up the County Wildland Fire Interagency Group. It is important that this group has representation from agencies with wildland fire suppression responsibilities:

- County Commissioners (Lead)
- Local Fire Chiefs
- Montana Department of Natural Resources and Conservation representative
- USDA Forest Service representative
- USDI Bureau of Land Management representative
- US Fish and Wildlife Service representative (from Charles M. Russell NWR)
- Bureau of Indian Affairs
- Local Tribal leaders
- Bureau of Disaster and Emergency Services
- LEPC Chairperson
- Resource Conservation and Development representative
- State Fish and Game representative

- Interested citizens and community leaders as appropriate
- Other officials as appropriate

If requested by the County Commissioners, the local Resource Conservation and Development Councils may be available to assist the County Commissioners in evaluating each County within their council area to determine if there is a wildland fire mitigation plan in place, or if a plan is currently in the development phase. If no plan is in place, the RC&D's, if requested, could be available to assist the Commissioners with the formation of the County Wildland Fire Interagency Group and/or to facilitate the development of a wildland fire mitigation plan.

If a plan has been previously completed, the Commissioners will determine if the recommended five elements have been addressed. The Counties will provide a copy of the completed mitigation plan to the Montana Department of Natural Resources and Conservation Fire Plan Coordinator, which will include a contact list of individuals that developed the plan.

1.1.2.3 National Association of State Foresters

1.1.2.3.1 Identifying and Prioritizing Communities at Risk

This plan is written with the intent to provide the information necessary for decision makers (elected officials) to make informed decisions in order to prioritize projects across the entire county. These decisions may be made from within the council of Commissioners, or through the recommendations of ad hoc groups tasked with making prioritized lists of projects. It is not necessary to rank projects numerically, although that is one approach, rather it may be possible to rank them categorically (high priority set, medium priority set, and so forth) and still accomplish the goals and objectives set forth in this planning document.

The following was prepared by the National Association of State Foresters (NASF), June 27, 2003, and is included here as a reference for the identification of prioritizing treatments between communities.

Purpose: To provide national, uniform guidance for implementing the provisions of the "Collaborative Fuels Treatment" MOU, and to satisfy the requirements of Task e, Goal 4 of the Implementation Plan for the 10-Year Comprehensive Strategy.

Intent: The intent is to establish broad, nationally compatible standards for identifying and prioritizing communities at risk, while allowing for maximum flexibility at the state and regional level. Three basic premises are:

- Include all lands and all ownerships.
- Use a collaborative process that is consistent with the complexity of land ownership patterns, resource management issues, and the number of interested stakeholders.
- Set priorities by evaluating projects, not by ranking communities.

The National Association of State Foresters (NASF) set forth the following guidelines in the Final Draft Concept Paper; Communities at Risk, December 2, 2002.

Task: Develop a definition for "communities at risk" and a process for prioritizing them, per the Implementation Plan for the 10-Year Comprehensive Strategy (Goal 4.e.). In addition, this definition will form the foundation for the NASF commitment to annually identify priority fuels reduction and ecosystem restoration projects in the proposed MOU with the federal agencies (section C.2 (b)).

1.1.2.3.2 Conceptual Approach

1. NASF fully supports the definition of the Wildland Urban Interface (WUI) previously published in the Federal Register. Further, proximity to federal lands should not be a consideration. The WUI is a set of conditions that exists on, or near, areas of wildland fuels nation-wide, regardless of land ownership.
2. Communities at risk (or, alternately, landscapes of similar risk) should be identified on a state-by-state basis with the involvement of all agencies with wildland fire protection responsibilities: state, local, tribal, and federal.
3. It is neither reasonable nor feasible to attempt to prioritize communities on a rank order basis. Rather, communities (or landscapes) should be sorted into three, broad categories or zones of risk: high, medium, and low. Each state, in collaboration with its local partners, will develop the specific criteria it will use to sort communities or landscapes into the three categories. NASF recommends using the publication "Wildland/Urban Interface Fire Hazard Assessment Methodology" developed by the National Wildland/Urban Interface Fire Protection Program (circa 1998) as a reference guide. (This program, which has since evolved into the Firewise Program, is under the oversight of the National Wildfire Coordinating Group (NWCG)). At minimum, states should consider the following factors when assessing the relative degree of exposure each community (landscape) faces.
    - **Risk:** Using historic fire occurrence records and other factors, assess the anticipated probability of a wildfire ignition.
    - **Hazard:** Assess the fuel conditions surrounding the community using a methodology such as fire condition class, or [other] process.
    - **Values Protected:** Evaluate the human values associated with the community or landscape, such as homes, businesses, and community infrastructure (e.g. water systems, utilities, transportation systems, critical care facilities, schools, manufacturing and industrial sites, and high value commercial timber lands).
    - **Protection Capabilities:** Assess the wildland fire protection capabilities of the agencies and local fire departments with jurisdiction.
4. Prioritize by project not by community. Annually prioritize projects within each state using the collaborative process defined in the national, interagency MOU "For the Development of a Collaborative Fuels Treatment Program". Assign the highest priorities to projects that will provide the greatest benefits either on the landscape or to communities. Attempt to properly sequence treatments on the landscape by working first around and within communities, and then moving further out into the surrounding landscape. This will require:
    - First, focus on the zone of highest overall risk but consider projects in all zones. Identify a set of projects that will effectively reduce the level of risk to communities within the zone.
    - Second, determining the community's willingness and readiness to actively participate in an identified project.
    - Third, determining the willingness and ability of the owner of the surrounding land to undertake, and maintain, a complementary project.

- Last, set priorities by looking for projects that best meet the three criteria above. It is important to note that projects with the greatest potential to reduce risk to communities and the landscape may not be those in the highest risk zone, particularly if either the community or the surrounding landowner is not willing or able to actively participate.

5. It is important, and necessary, that we be able to demonstrate a level of accomplishment that justifies to Congress the value of continuing the current level of appropriations for the National Fire Plan. Although appealing to appropriators and others, it is not likely that many communities (if any) will ever be removed from the list of communities at risk. Even after treatment, all communities will remain at some, albeit reduced, level of risk. However, by using a science-based system for measuring relative risk, we can likely show that, after treatment (or a series of treatments), communities are at "*reduced risk*".

Similarly, scattered, individual homes that complete projects to create defensible space could be "counted" as "households at reduced risk". This would be a way to report progress in reducing risk to scattered homes in areas of low priority for large-scale fuels treatment projects.

Using the concept described above, the NASF believes it is possible to accurately assess the relative risk that communities face from wildland fire. Recognizing that the condition of the vegetation (fuel) on the landscape is dynamic, assessments and re-assessments must be done on a state-by-state basis, using a process that allows for the integration of local knowledge, conditions, and circumstances, with science-based national guidelines. We must remember that it is not only important to lower the risk to communities, but once the risk has been reduced, to maintain those communities at a reduced risk.

Further, it is essential that both the assessment process and the prioritization of projects be done collaboratively, with all local agencies with fire protection jurisdiction – federal, state, local, and tribal – taking an active role.

1.1.2.4 Healthy Forests Restoration Act

On December 3, 2003, President Bush signed into law the Healthy Forests Restoration Act of 2003 to reduce the threat of destructive wildfires while upholding environmental standards and encouraging early public input during review and planning processes. The legislation is based on sound science and helps further the President's Healthy Forests Initiative pledge to care for America's forests and rangelands, reduce the risk of catastrophic fire to communities, help save the lives of firefighters and citizens, and protect threatened and endangered species.

Among other things the Healthy Forests Restoration Act (HFRA):

- Strengthens public participation in developing high priority projects;
- Reduces the complexity of environmental analysis allowing federal land agencies to use the best science available to actively manage land under their protection;
- Creates a pre-decisional objections process encouraging early public participation in project planning; and
- Issues clear guidance for court action challenging HFRA projects.

The Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan is developed to adhere to the principles of the HFRA while providing recommendations consistent with the policy document which should assist the federal land management agencies (US Forest Service, Bureau of Land Management, and the US Fish Wildlife Service) with implementing wildfire

mitigation projects in Petroleum County that incorporate public involvement and the input from a wide spectrum of fire and emergency services providers in the region.

1.1.3 Local Guidelines

1.1.3.1 Petroleum County Fire Mitigation Planning Effort and Philosophy

The goals of this planning process include the integration of the National Fire Plan, the Western Governors Association Implementation Strategy, the Healthy Forests Restoration Act, and the requirements of FEMA for a county-wide Fire Mitigation Plan; a component of the County's All Hazards Mitigation Plan. This effort will utilize the best and most appropriate science from all partners, the integration of local and regional knowledge about wildfire risks and fire behavior, while meeting the needs of local citizens, the regional economy, the significance of this region to the rest of Montana and the Inland West.

1.1.3.1.1 Mission Statement

To make Petroleum County residents, communities, state agencies, local governments, and businesses less vulnerable to the negative effects of wildland fires through the effective administration of wildfire hazard mitigation grant programs, hazard risk assessments, wise and efficient fuels treatments, and a coordinated approach to mitigation policy through federal, state, regional, and local planning efforts. Our combined prioritization will be the protection of people, structures, infrastructure, and unique ecosystems that contribute to our way of life and the sustainability of the local and regional economy.

1.1.3.1.2 Vision Statement

Institutionalize and promote a countywide wildfire hazard mitigation ethic through leadership, professionalism, and excellence, leading the way to a safe, sustainable Petroleum County.

1.1.3.1.3 Goals

- To reduce the area of WUI land burned and losses experienced because of wildfires where these fires threaten communities in the wildland-urban interface
- Prioritize the protection of people, structures, infrastructure, and unique ecosystems that contribute to our way of life and the sustainability of the local and regional economy
- Educate communities about the unique challenges of wildfire in the wildland-urban interface (WUI)
- Establish mitigation priorities and develop mitigation strategies in Petroleum County
- Strategically locate and plan fuel reduction projects
- Provide recommendations for alternative treatment methods, such as modifying forest stand density, herbicide treatments, fuel reduction techniques, and disposal or removal of treated slash
- Meet or exceed the requirements of the National Fire Plan and FEMA for a County level Fire Mitigation Plan

Chapter 2: Planning Process

2 Documenting the Planning Process

Documentation of the planning process, including public involvement, is required to meet FEMA's DMA 2000 (44CFR§201.4(c)(1) and §201.6(c)(1)). This section includes a description of the planning process used to develop this plan, including how it was prepared, who was involved in the process, and how all of the involved agencies participated.

2.1.1 Description of the Planning Process

The Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan was developed through a collaborative process involving all of the organizations and agencies detailed in Section 1.0 of this document. The County's local coordinator contacted these organizations directly to invite their participation and schedule meetings of the planning committee. The planning process included 5 distinct phases which were in some cases sequential (step 1 then step 2) and in some cases intermixed (step 4 completed though out the process):

1. **Collection of Data** about the extent and periodicity of wildfires in and around Petroleum County. This included an area encompassing Fergus and Judith Basin Counties to insure a robust dataset for making inferences about fires in Petroleum County specifically; this included a wildfire extent and ignition profile.
2. **Field Observations and Estimations** about wildfire risks including fuels assessments, juxtaposition of structures and infrastructure to wildland fuels, access, and potential treatments by trained wildfire specialists.
3. **Mapping** of data relevant to wildfire control and treatments, structures, resource values, infrastructure, fire prone landscapes, and related data.
4. **Facilitation of Public Involvement** from the formation of the planning committee, to a public mail survey, news releases, public meetings, public review of draft documents, and acceptance of the final plan by the signatory representatives.
5. **Analysis and Drafting of the Report** to integrate the results of the planning process, providing ample review and integration of committee and public input, followed by acceptance of the final document.

Planning efforts were led by the Project Director, Dr. William E. Schlosser, of Northwest Management, Inc. Dr. Schlosser holds 4 degrees in natural resource management (A.S. geology; B.S. forest and range management; M.S. natural resource economic & finance; Ph.D. environmental science and regional planning). Mr. Gary Ellingson, holds a degree in forest resource management, and manages the Montana Office of Northwest Management, Inc. Together, they led a team of resource professionals that included fire mitigation specialists, wildfire control specialists, resource management professionals, and hazard mitigation experts.

They were the point-people for team members to share data and information with during the plan's development. They and the planning team met with many residents of the county during the inspections of communities, infrastructure, and hazard abatement assessments. This methodology, when coupled with the other approaches in this process, worked effectively to integrate a wide spectrum of observations and interpretations about the project.

The planning philosophy employed in this project included the open and free sharing of information with interested parties. Information from federal and state agencies was integrated

into the database of knowledge used in this project. Meetings with the committee were held throughout the planning process to facilitate a sharing of information between cooperators.

When the public meetings were held, many of the committee members were in attendance and shared their support and experiences with the planning process and their interpretations of the results.

2.2 Public Involvement

Public involvement in this plan was made a priority from the inception of the project. There were a number of ways that public involvement was sought and facilitated. In some cases this led to members of the public providing information and seeking an active role in protecting their own homes and businesses, while in other cases it led to the public becoming more aware of the process without becoming directly involved in the planning process.

2.2.1 News Releases

Under the auspices of the Petroleum County Wildland-Urban Interface Wildfire Mitigation Planning Committee, news releases were submitted to area newspapers and radio.

2.2.1.1 Radio Messages

A short news release was aired over the KXLO and KLCM radio station the week prior to the public meetings announcing the goals of the planning committee, the purpose of the mitigation plan, the date and times of public meetings, and contact information.

2.2.1.2 Newspaper Articles

Committee and public meeting announcements were published in the local newspaper ahead of each meeting. The following is an announcement that ran in the local newspaper.

Hot Topic: Petroleum County Plans to Mitigate Wildfire Risk

Roundup, MT --- The Petroleum County Commissioners, working with Snowy Mountain Development Corporation, have created a Wildfire Mitigation Plan Committee to complete a Wildfire Mitigation Plan for Petroleum County as part of the National Fire Plan authorized by Congress and the Whitehouse. The Petroleum County Wildfire Mitigation Plan will include risk analysis at the community level with predictive models for where fires are likely to ignite and where they are likely to spread rapidly once ignited. Northwest Management, Inc. has been retained by Petroleum County to provide wildfire risk assessments, mapping, field inspections, and interviews, and to collaborate with the committee to prepare the plan. The coordination for this effort is being provided by Kathie Bailey of Snowy Mountain Development Corp. The committee includes rural and wildland fire districts, land managers, elected officials, agency representatives, and others. Northwest Management specialists are conducting analyses of fire prone landscapes and making recommendations for potential treatments. Specific activities for homes, structures, infrastructure, and resource capabilities will be proposed as part of the analysis.

One of the most important steps in gathering information about fire risk in Petroleum County is to conduct a homeowner's survey. Northwest Management, Inc., in cooperation with local fire officials, have mailed a brief survey to randomly selected homeowners in the county seeking details about home construction materials, proximity to water sources, and other risk factors surrounding homes. This survey is very important to the success of the plan. Those homes that

receive a survey are asked to please take the time to complete it, thereby benefiting the community overall.

The planning team will be conducting Public Meetings to discuss preliminary findings and to seek public involvement in the planning process in June. For more information on the Fire Mitigation Plan project in Petroleum County contact your County Commissioner, Northwest Management, Inc. project director Dr. William Schlosser (208) 883-4488, Gary Ellingson of Northwest Management, Inc. (406) 442-7555 or Kathie Bailey at 406-350-0198.

Public Information Meeting: June 17th at the Winnett Courthouse at 7:00PM

2.2.2 Public Mail Survey

In order to collect a broad base of perceptions about wildland fire and individual risk factors of homeowners in Petroleum County, a mail survey was conducted. Using a state and county database of landowners in Petroleum County, homeowners from the Wildland-Urban Interface surrounding each community were identified. In order to be included in the database, individuals were selected that own property and have a dwelling in Petroleum County, as well as a mailing address in Petroleum County. This database created a list of 226 unique names of which all were selected to receive a the public mail survey.

The public mail survey developed for this project has been used in the past by Northwest Management, Inc., during the execution of other WUI Wildfire Mitigation Plans. The survey used The Total Design Method (Dillman 1978) as a model to schedule the timing and content of letters sent to the selected recipients. Copies of each cover letter, mail survey, and communication are included in Appendix III.

The first in the series of mailing was sent May 27, 2004, and included a cover letter, a survey, and an offer of receiving a custom GIS map of the area of their selection in Petroleum County if they would complete and return the survey. The free map incentive was tied into assisting their community and helping their interests by participating in this process. Each letter also informed residents about the planning process. A return self-addressed enveloped was included in each packet. A postcard reminder was sent to the non-respondents on June 4, 2004, encouraging their response. A final mailing, with a revised cover letter pleading with them to participate, was sent to non-respondents on June 17, 2004.

Surveys were returned during the months of June and July. A total of 79 residents responded to the survey. No surveys were returned as undeliverable. The effective response rate for this survey was 35%. Statistically, this response rate allows the interpretation of all of the response variables significantly at the 95% confidence level.

2.2.2.1 Survey Results

A summary of the survey's results will be presented here and then referred back to during the ensuing discussions on the need for various treatments, education, and other information.

All of the respondents have a home in Petroleum County, and 93% consider this their primary residence. About 72% of the respondents were from the Winnett area, 6% were from the Dovetail area, 5% were from the Petrolia Bench area, 5% from Flatwillow, 3% from Cat Creek, 3% from Mosby, with the remainder were from Melstone, Grass Range, Fergus, and Petroleum.

All of the respondents (100%) correctly identified that they have emergency telephone 911 services in their area. However, their ability to correctly identify if they are covered by a rural fire district was less than hoped. Respondents were asked to identify if their home is protected by a rural or city fire district. All of Petroleum County is protected by the Petroleum County Fire

Company. Of the respondents, 92% correctly identified they live in an area protected by a rural or city fire district. Approximately 8% responded they do not have a fire district covering their home, when in fact they do.

Respondents were asked to indicate the type of roofing material covering the main structure of their home. Approximately 33% of respondents indicated their homes were covered with a composite material (asphalt shingles). About 43% indicated their home were covered with a metal (eg., aluminum, tin) roofing material. Roughly 11% of the respondents indicated they have a wooden roofing material such as shakes or shingles. The additional 13% of respondents had a variety of combustible and non-combustible materials indicated.

Residents were asked to evaluate the proximity of trees within certain distances of their homes. Often, the density of trees around a home is an indicator of increased fire risk. The results are presented in Table 2.1

Table 2.1 Survey responses indicating the proximity of trees to homes.

Number of Trees	Within 250 feet of your home	Within 75 feet of your home
None	11%	17%
Less than 10	50%	60%
Between 10 and 25	27%	29%
More than 25	21%	11%

Approximately 92% of those returning the survey indicated they have a lawn surrounding their home. Of these individual home sites, 84% indicated they keep this lawn green through the fire season.

The average driveway length of the respondents was approximately 2,024 feet long, from their main road to their parking area. Roughly 40% of the respondents had a driveway over ¼ mile long. Of these homes with lengthy driveways, roughly 75% have turnouts allowing two vehicles to pass each other in the case of an emergency. Approximately 95% of all homeowners indicated they have an alternative escape route, with the remaining 5% indicating only one-way-in and one-way-out.

Nearly all respondents (95%) indicated they have some type of tools to use against a wildfire that threatens their home. Table 2.2 summarizes these responses.

Table 2.2. Percent of homes with indicated fire fighting tools in Petroleum County.

92% – Hand tools (shovel, Pulaski, etc.)
51% – Portable water tank
38% – Stationery water tank
42% – Pond, lake, or stream water supply close
49% – Water pump and fire hose
45% – Equipment suitable for creating fire breaks (bulldozer, cat, skidder, etc.)

Roughly 34% of the respondents in Petroleum County indicated they have someone in their household trained in wildland fire fighting. Approximately 20% indicated someone in the household had been trained in structural fire fighting. However, it is important to note that these questions did not specify a standard nor did it refer to how long ago the training was received.

A couple of questions in the survey related to on-going fire mitigation efforts households may be implementing. Respondents were asked if they conduct a periodic fuels reduction program near

their home sites, such as grass or brush burning. Approximately 42% answered affirmative to this question, while 58% responded that livestock (cattle, horses, sheep) graze the grasses and forbs around their home sites.

Respondents were asked to complete a fuel hazard rating worksheet to assess their home's fire risk rating. An additional column titled "results" has been added to the table, showing the percent of respondents circling each rating (Table 2.3).

Circle the ratings in each category that best describes your home.

Table 2.3. Fuel Hazard Rating Worksheet		Rating	Results
Fuel Hazard	Small, light fuels (grasses, forbs, weeds, shrubs)	1	79%
	Medium size fuels (brush, large shrubs, small trees)	2	21%
	Heavy, large fuels (woodlands, timber, heavy brush)	3	0%
Slope Hazard	Mild slopes (0-5%)	1	82%
	Moderate slope (6-20%)	2	18%
	Steep Slopes (21-40%)	3	0%
	Extreme slopes (41% and greater)	4	0%
Structure Hazard	Noncombustible roof and noncombustible siding materials	1	40%
	Noncombustible roof and combustible siding material	3	32%
	Combustible roof and noncombustible siding material	7	15%
	Combustible roof and combustible siding materials	10	13%
Additional Factors	Rough topography that contains several steep canyons or ridges	+2	Average -2.4 pts
	Areas having history of higher than average fire occurrence	+3	
	Areas exposed to severe fire weather and strong winds	+4	
	Areas with existing fuel modifications or usable fire breaks	-3	
	Areas with local facilities (water systems, rural fire districts, dozers)	-3	

Calculating your risk

Values below are the average response value to each question.

Fuel hazard __1.2___ x Slope Hazard ____1.1___ = ____1.32____		
Structural hazard	+	___3.9__
Additional factors	(+ or -)	___-2.4__
Total Hazard Points	=	____2.82__.

Table 2.4. Percent of respondents in each risk category as determined by the survey respondents.
00% – Extreme Risk = 26 + points
00% – High Risk = 16–25 points
14% – Moderate Risk = 6–15 points
86% – Low Risk = 6 or less points

Maximum household rating form score was 14 points, as assessed by the homeowners. These numbers were compared to observations made by field crews trained in wildland fire fighting. These results indicate that for the most part, these indications are only slightly lower than the risk rating assigned by the "professionals". Anecdotal evidence would indicate that Petroleum County landowners involved in this survey have a more realistic view of wildfire risk than the landowners in other Montana counties where these questions have been asked.

Finally, respondents were asked "if offered in your area, would members of your household attend a free, or low cost, one-day training seminar designed to teach homeowners in the wildland–urban interface how to improve the defensible space surrounding your home and adjacent outbuildings?" A majority of the respondents, 52% indicated a desire to participate in this type of training.

2.2.2.2 Committee Meetings

The following list of people who participated in the planning committee meetings, volunteered time, or responded to elements of the Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan's preparation.

- Chris King.....County Commissioner
- Dave Grantier.....Petroleum County Firewarden
- Gary Ellingson.....Northwest Management, Inc
- Kardy Eickhoff.....City Council & Winnett Volunteer Fire Department
- Kathie Bailey .....Snowy Mountain Development Corporation
- Lee Iverson .....County Commissioner
- Leonard Eickhoff .....Winnett Volunteer Fire Department
- Lloyd Rowton .....County Commissioner
- Jerry Buhre.....Department of Natural Resources & Conservation
- Shauna Clark .....Petroleum County Conservation District
- Mike Granger .....US Fish & Wildlife Service (C. M. Russell NWR)
- Toby Brown.....Northwest Management, Inc.
- John Erixson .....Northwest Management, Inc.
- Vincent P. Corrao.....Northwest Management, Inc.
- William E. Schlosser .....Northwest Management, Inc.

Committee Meetings were scheduled and held on the following dates:

April 15, 2004

Attendance list was signed by all present and collected by Bill Schlosser.

Bill Schlosser of Northwest Management, Inc. made introductions and stated that the purpose for the initial meeting is to describe the fuel mitigation planning process and explain the role committee members will have in developing the plan for their county. Committee members can anticipate 3-4 meetings over the next several months. Future meetings will be focused on completing portions of the plan document and involve hands on planning and input from committee members. Bill emphasized that the plan will be submitted to county commissioners for their signature and that their sustained involvement in the process is especially important. All committee members and their respective organizations will be asked to sign off on the completed plan.

Bill reviewed standards that will apply to the planning document. Pertinent standards are contained within FEMA All Hazards Mitigation Plan, National Fire Plan, Healthy Forests Restoration Act, and DNRC's Statewide Implementation Strategies.

Questions and Comments from the Committee Members

Development of a mutual aid agreement with CMR Wildlife Refuge may be a possibility. Existing agreements are in place with surrounding counties. BLM will often send 1 engine. DNRC has slip in truck at Hedman Ranch, Type 6 at Woodford and Iverson Ranches, and a Type 5 at the Ty Lund property.

Gary Kirkpatrick is USFS point person

No growth plan in county

No USFS ownership in county

Municipal water all wells

Electric substation located in town- Fergus electric power supply located in Lewistown.

Fire department is dispatched thru 911 in Lewistown

Many non-residents in county

County Assessor is located in Jordan, Montana

Local newspapers to announce public meetings are the Argus News, Lewistown; Roundup Record Tribune, and Winnett Times (weekly).

Mail survey question 1 should be modified to ask if home is a primary residence, 2nd home, hunting cabin or other

Mid-rivers is the local phone company

Oil fields are present in 3 areas – Rattlesnake Butte, Cat Creek, and one other

Need to have DES coordinator attend next meeting

Roads layer is available thru Linda at Fergus County, but not all roads have been located with GPS. Many structures may not be located also. Approx. 600 miles of road in the county

Fire chiefs would like to have aerial photography coverage

County population is approximately 500

Bill outlined possible funding opportunities that may become available if the mitigation plan meets requirements of various funding sources. The fuels mitigation plan will be designed and

written to enable the community to seek assistance from USFS, BLM, FEMA, DNRC, and other sources that may become available in the future.

Bill spoke about the strategy for planning and described what data will be collected and used in development of the plan utilizing GIS. He also provided definitions of Wildland Urban Interface and reviewed the public comment process.

Bill distributed the draft Petroleum County Community Assessment and requested that all committee members review it and provide written response prior to the next meeting. Bill will try to summarized all comments and bring a 2nd draft to the next meeting. Bill also distributed an example public mail survey and requested comments. A survey of Resource and Capabilities was sent to fire districts for completion by local fire chiefs, BLM, and DNRC.

The next meeting date was set for May 13th at 9 am. Kathie will mail meeting notices.

May 13, 2004

Attendance list was signed by all present and collected by Bill Schlosser

Bill Schlosser, of Northwest Management Inc. (NMI), made introductions and stated that the purpose for the meeting is to identify important infrastructure within the county on the county maps he has prepared. The committee worked as a group to: review road labels, identify missing roads, identify approximate locations powerlines , radio towers and phone lines.

The committee also identified primary roads with green and secondary roads with blue on the map. Oil field locations were marked with brown outline. Airstrips were noted with green X. There may be justification for a 2nd airstrip on north end of the county near the primary access route. The location of fire trucks were marked in red with FTX.

Bill asked for comments on the mail survey. The committee approved mailing out of the survey as it is.

Written comments were provided on the community assessment. These comments will be incorporated into the draft document.

The public meeting was scheduled for 7pm on June 17th in the basement of the courthouse.

The committee will meet prior to the public meeting on the same date at 4:30 pm. Kathy will mail meeting notices to committee members. NMI will advertise the public meeting in local newspapers.

<u>Questions and comments from committee members:</u>

NMI will do additional field work to GPS the locations of roads and powerlines missing on the map.

There is no enhanced 911 service. 911 callers will get either Lewistown or Harlowton.

Another emergency repeater would be beneficial in the north end of the county near Two Crow Creek or Dovetail Butte (both locations were indicated on the map).

There are some subdivisions along the west central portion of the county line which should be evaluated.

Rural addresses are delivered twice a week. Not all roads are delivered. PO will ensure correct delivery to local residents.

County fair is the last week of July.

Lee will write up a summary of previous mitigations activities.

The county has no logo.

June 17, 2004

Attendance list was signed by all present and collected by Toby Brown. Attendees were:

Lee Iverson, Chris King, Leonard Eickhoff, Kardy Eickhoff , Daniel J. Grants, Gary Ellingson and Toby Brown.

Toby Brown, of Northwest Management Inc. (NMI), started the meeting by handing out agendas.

The maps that had been made from the input of the last committee meeting were reviewed. Corrections included the changing of some road names and the addition of one road. Comments were made that the symbols for fire truck location should be bigger.

There were no additional comments on the previous community assessments. There was a general discussion on the impact of fires on the existing oil fields. No one could recall having seen any wells or tanks burn as a result of a wildfire burning near by.

The resource and capabilities surveys handed out at the last meeting were returned. There is only one for the whole county.

An engaging discussion on possible mitigation measures for the county covered the remainder of the meeting. No past or current fuel hazard reduction projects are known to have happened or to be planned in the county. County is in need of more volunteer firefighters. Many local residences show up when there is a fire, but often they have little or no wildland firefighting experience. Getting these people to come to training sessions and to join the local volunteer fire department when fires aren't burning is problematic. Need some incentives to get them to join. One idea was to form a lower level auxiliary force that would do just the basic wildland training (red carded) and not be required to do the more intensive structure training. This group could then be utilized for assisting on wildland fires.

The committee broke for dinner, with the commitment to return and discuss more mitigation measures after the public meeting the same evening.

July 15, 2004

Attendance list was signed by all present and collected by Vincent Corrao; Attendees were:

Kathie Bailey, Lee Iverson, David Grantier, Lloyd Rowton, Kardy Eickhoff, Leonard Eickholl, Jerry Buhre, Shauna Clark, John Erixson, Vincent Corrao

Vincent Corrao began the meeting with an introduction and explained the purpose of the meeting as presenting the Draft Fire Mitigation Plan.

Comments on the Draft Plan were as follows:

Winnett Volunteer Fire Department should be listed in the acknowledgements at the beginning of the document.

Chapter 1: Explanation of funding—FEMA, Fire Plan, Restoration Act. Discussion by Vincent of Petroleum Cty. Mission statement, Vision statement, goals statement. Discussion on Restoration Act. Kathy commented that the Charles M. Russell Wildlife Refuge (CMR) has been invited to attend committee meetings every time. David Grantier commented that there are not many homes in CMR, but there is poor access into CMR. This can cause larger fires. Lloyd commented there is a problem with no allowed access into CMR. DNRC says you can override CMR and fight fires on CMR.

Chapter 2: Should document people who were invited in minutes of meetings to document that we wanted CMR involvement. There is no mutual aid agreement with CMR. USF&W have initial attack response on CMR; BLM dispatches CMR crews; operations plan needs to be done—no one does this very well now. There was a discussion of mutual aid agreement with CMR and BLM.

Chapter 3: Jerry thought there were more fires in the county than reported in the draft document. County will submit list.

Chapter 4: Request a cell tower for communication!!

Chapter 5: Treatments on CMR; Mututal aid; Can we get training for fire fighters and personnel. Working on getting another class for emergency services. Can we get more cell towers? Is there a replacement cycle for equipment? Concerns on too much vegetation on CMR—Can we bring in the BLM and US Forest Service in for discussion on risk and fire fighting. Discussion on who is fire warden in county. Make one person the contact for operational purposes.

Locations for Draft Plan for Public Review: Library, Court House, BLM office, NRCS.

2.2.2.3 Public Meetings

A public meeting was held as an integral component to the planning process. It was the desire of the planning committee, and the Petroleum County Commissioners to integrate the public's input to the development of the fire mitigation plan.

The formal public meeting was scheduled on June 17, 2004, at Winnett, Montana. The purpose of the meeting was to share information on the planning process with a broadly representative cross section of Petroleum County landowners. Wall maps were posted in the meeting room with many of the analysis results summarized specifically for the risk assessments, location of structures, fire protection, and related information. The formal portion of the presentation included a PowerPoint presentation made by Project Specialist, Toby Brown. During his presentation, comments from committee members, fire chiefs, and others were encouraged in an effort to engage the audience in a discussion.

It was made clear to all in attendance that their input was welcome and encouraged, as specific treatments had not yet been decided, nor had the risk assessment been completed. Attendees were told that they could provide oral comment during the meeting, they could provide written comment to the meeting, or they could request more information in person to discuss the plan. In addition, attendees were told they would have an opportunity to review the draft plan prior to its completion to further facilitate their comments and input.

The formal presentation lasted approximately 1 hour and included many questions and comments from the audience. Following the meeting, many discussions continued with the committee members and the general public discussing specific areas, potential treatments, the risk analysis, and other topics.

Attendance at the public meeting included 6 individuals. The following are comments, questions or suggestions from the meetings:

2.2.2.3.1 Winnett Public Meeting

June 17, 2004 – Petroleum County Courthouse

County Commissioners Office - 4:00 pm

Attendance list was signed by all present and collected by Toby Brown. Attendees were:

Lee Iverson, Chris King, Leonard Eickhoff, Kardy Eickhoff , Daniel J. Grants, Terrance Pugrud, Gary Ellingson and Toby Brown.

Toby Brown, of Northwest Management Inc. (NMI), began the meeting with a slide show of what Fire Mitigation Plans are, how they were authorized and funded, who had been involved and what work had been done to date.

After the presentation there was a general discussion about what mitigation needs existed in the county. Many ideas were discussed.

Roadside treatments next to primary and secondary roads. Specifically near the junction of Dovetail and Dunn Ridge roads. Thick timber exists right down to the edge of these escape routes. Work needs to be down in this area so that a fire burning through would not close these roads. It's believed the property is BLM and private.

Sections of the 79 Trail Road were also noted to be in need of treatment where heavy fuels exist along the road.

When fires occur in the county often local farmers are the first responders with their spray trucks. The local Fire chief would like to start a program to train, and equip (Nomex and radios) these people so they could be more effective in helping fight the fire. Often there is no communication with these first responders and knowing where they are and what they are doing can be difficult. Financial assistance to provide PPE and communications equipment would be necessary.

Education of non-residence (summer home/ hunting cabins) on the need to provide defensible space around their structures. As more people form outside the area build summer homes and hunting cabins there is a need to educate these individuals on the hazards of living in a fire environment.

Volunteer recruitment program. Possibly thru the High School.

Road signs, although the group felt that this was a lower priority.

Road improvements some of the Primary and secondary roads (Dunn Ridge, 79 Trail and Lower River Road) are not all season roads. In many cases these are native dirt roads that can become quickly impassable when thunderstorms hit. Often there are lightning caused fire in the area and sections of roads that are impassible due to rain that might be 10 miles from the fire. Also some sections of roads are surfaced with loose surface material making moving heavy water tankers problematic.

The Bridge on Old Cat Creek Road over Box Canyon has recently been downgraded to 5 tons. Getting this bridge repaired/improved would help access to the east side of the county for the larger fire trucks.

Water availability in the back country is often an issue. Storage tanks, water bladders or better drafting sites along the Musselshell River or Fort peck reservoir. Water is scarce and farmer/ranchers are reluctant to give up the water in their storage/stock ponds. Water rights on the Musselshell or Fort Peck reservoir to help refill water taken from these ponds would help encourage ranches to make there water available to fire fighting crews. As part of this a county ordinance making it mandatory to refill, once a water right ahs been established would also help make these water sources available. Once concern is the cost to refill stock ponds. A large tanker is needed and the funds to operate it both for refilling ponds and delivering water to fires.

2.2.2.3.2 Meeting Notices

Public notices of this meeting were printed in the Roundup Record-Tribune & Winnett Times the week of June 7th-11th, 2004 and June 14th-17th, 2004. The following is an example of one of these notices.

Hot Topic: Petroleum County Plans to Mitigate Wildfire Risk

Roundup, MT --- The Petroleum County Commissioners, working with Snowy Mountain Development Corporation, have created a Wildfire Mitigation Plan Committee to complete a Wildfire Mitigation Plan for Petroleum County as part of the National Fire Plan authorized by Congress and the White House. The Petroleum County Wildfire Mitigation Plan will include risk analysis at the community level with predictive models for where fires are likely to ignite and where they are likely to spread rapidly once ignited. Northwest Management, Inc. has been retained by Petroleum County to provide wildfire risk assessments, mapping, field inspections, and interviews, and to collaborate with the committee to prepare the plan. The coordination for this effort is being provided by Kathie Bailey of Snowy Mountain Development Corp. The committee includes rural and wildland fire districts, land managers, elected officials, agency representatives, and others. Northwest Management, Inc. specialists are conducting analyses of fire prone landscapes and making recommendations for potential treatments. Specific activities for homes, structures, infrastructure, and resource capabilities will be proposed as part of the analysis.

One of the most important steps in gathering information about fire risk in Petroleum County is to conduct a homeowner's survey. Northwest Management, Inc., in cooperation with local fire officials, have mailed a brief survey to randomly selected homeowners in the county seeking details about home construction materials, proximity to water sources, and other risk factors surrounding homes. This survey is very important to the success of the plan. Those homes that receive a survey are asked to please take the time to complete it, thereby benefiting the community overall.

The planning team will be conducting Public Meetings to discuss preliminary findings and to seek public involvement in the planning process in June. For more information on the Fire Mitigation Plan project in Petroleum County contact your County Commissioner, Northwest Management, Inc. project director Dr. William Schlosser (208) 883-4488, Gary Ellingson of Northwest Management, Inc. (406) 442-7555 or Kathie Bailey at 406-350-0198.

Public Information Meeting: June 17th at the Winnett Courthouse at 7:00 PM.

2.3 Review of the WUI Wildfire Mitigation Plan

Review of sections of this document were conducted by the planning committee during the planning process as maps, summaries, and written assessments were completed. These individuals included fire mitigation specialists, fire fighters, planners, elected officials, and others involved in the coordination process. Preliminary findings were discussed at the public meetings, where comments were collected and facilitated.

The results of these formal and informal reviews were integrated into a DRAFT Wildland-Urban Interface Wildfire Mitigation Plan. This plan was given to members of the planning committee (including the Petroleum County Commissioners and the Snowy Mountain Development Corporation) on July 15, 2004. One comment the County would like documented was that a Mutual Agreement between the County Fire Departments and the CMR is needed and to implement an operational plan to dispatch fire personnel.

Public review of the plan was made from August 16-30, 2004. Copies of the plan were available at the County Courthouse and delivered to those requesting copies. Written and verbal comments were collected during this period and incorporated into the completed plan.

Final acceptance of this Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan was made a regular session of the Petroleum County Commissioners Meeting in Winnett, Montana, on September 7, 2004.

Chapter 3: County Characteristics & Risk Assessment

3 Background and Area Description

3.1 History

On May 20, 1805, members of the Lewis and Clark expedition discovered the Musselshell River, the present eastern boundary of Petroleum County. The Crow, Blackfoot, Nez Perce, and Sioux Indian tribes were then hunting in the area that this soil survey comprises. A trading post built at the mouth of the Musselshell River in the spring of 1868 became the settlement known as Musselshell, which reached its peak activity by the following spring.

Winnett, a town near the center of the county, dates to 1879. Its founder, Walter Winnett, was one of the area's earliest settlers. Winnett, the largest town in Petroleum County is the county seat.

Stockgrowers began moving into the area along the Musselshell River soon after the establishment of Fort Maginnis in 1880. The discovery of gold in what is now the adjoining Fergus County, helped to spur this influx. From 1911 to 1915, squatters and homesteaders set up on practically every 320-acre parcel in the area. The land on many of these homesteads that were abandoned during the 1930's subsequently reverted to property of the U.S. Government.

Petroleum County was named after its principal industry, the production of petroleum, or crude oil. On February 18, 1920, high grade oil was struck at the Cat Creek field in the southeast corner of the county. The field produced more than 2,200,000 barrels of oil in 1922.

Petroleum County was established on February 22, 1925, from part of Fergus County. As the last county established in Montana, in 1944 it adopted the county manager form of government still in use today. The 1980 census showed that Petroleum County had one of the lowest populations of a county in the country, 655. (Soil Survey of Petroleum County, Montana, USDA, Soil Conservation Service).

3.2 Demographics

Petroleum County reported a decrease in total population from 519 in 1990 to 493 in 2000 with approximately 292 housing units. Petroleum County has one incorporated community, Winnett (pop. 185). Nearly 38% of the total county population resides in Winnett.

Table 3.1 summarizes some relevant demographic statistics for Petroleum County.

Table 3.1. Selected demographic statistics for Petroleum County, Montana, from Census 2000.

Subject	Number	Percent
Total population	**493**	**100.0**
SEX AND AGE		
Male	257	52.1
Female	236	47.9
Under 5 years	34	6.9
5 to 9 years	37	7.5
10 to 14 years	35	7.1

Table 3.1. Selected demographic statistics for Petroleum County, Montana, from Census 2000.

Subject	Number	Percent
15 to 19 years	32	6.5
20 to 24 years	22	4.5
25 to 34 years	55	11.2
35 to 44 years	61	12.4
45 to 54 years	81	16.4
55 to 59 years	18	3.7
60 to 64 years	37	7.5
65 to 74 years	54	11.0
75 to 84 years	24	4.9
85 years and over	3	0.6
Median age (years)	38.8	(X)
18 years and over	366	74.2
Male	192	38.9
Female	174	35.3
21 years and over	354	71.8
62 years and over	101	20.5
65 years and over	81	16.4
Male	44	8.9
Female	37	7.5
RELATIONSHIP		
Population	**493**	**100.0**
In households	493	100.0
Householder	209	42.4
Spouse	127	25.8
Child	135	27.4
Own child under 18 years	123	24.9
Other relatives	7	1.4
Under 18 years	2	0.4
Nonrelatives	15	3.0
Unmarried partner	8	1.6
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Households	**209**	**100.0**
Family households (families)	138	66.0
With own children under 18 years	71	34.0
Married-couple family	118	56.5
With own children under 18 years	54	25.8
Female householder, no husband present	14	6.7
With own children under 18 years	12	5.7

Table 3.1. Selected demographic statistics for Petroleum County, Montana, from Census 2000.

Subject	Number	Percent
Nonfamily households	71	34.0
Householder living alone	63	30.1
Householder 65 years and over	29	13.9
Households with individuals under 18 years	75	35.9
Households with individuals 65 years and over	81	38.8
Average household size	2.36	(X)
Average family size	2.95	(X)
HOUSING TENURE		
Occupied housing units	**211**	**100.0**
Owner-occupied housing units	157	74.4
Renter-occupied housing units	54	25.6
Average household size of owner-occupied unit	2.22	(X)
Average household size of renter-occupied unit	2.67	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

3.3 Socioeconomics

Petroleum County had a total of 292 housing units (211 occupied) and a population density of 0.3 persons per square mile reported in the 2000 Census. Ethnicity in Petroleum County is distributed: white 99.2%, American Indian or Alaskan Native 0.2%, Hispanic or Latino 1.2%, and two or more races 0.4%. Petroleum County is the sixth smallest county in the nation (by population); and it is the smallest county by population in the state of Montana.

Specific economic data for individual communities is collected by the US Census; in Petroleum County this only includes Winnett. Winnett households earn a median income of $17,361 annually, which compares to the Petroleum County median income during the same period of $24,107. Table 3.2 shows the dispersal of households in various income categories in Petroleum County.

Table 3.2. Income in 1999	Petroleum County	
	Number	Percent
Households	**209**	**100.0**
Less than $10,000	47	22.5
$10,000 to $14,999	24	11.5
$15,000 to $24,999	36	17.2
$25,000 to $34,999	42	20.1
$35,000 to $49,999	19	9.1
$50,000 to $74,999	24	11.5

Table 3.2. Income in 1999	Petroleum County	
	Number	Percent
$75,000 to $99,999	5	2.4
$100,000 to $149,999	4	1.9
$150,000 to $199,999	2	1.0
$200,000 or more	6	2.9
Median household income (dollars)	24,107	(X)

(Census 2000)

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, directs federal agencies to identify and address any disproportionately high adverse human health or environmental effects of its projects on minority or low-income populations. In Petroleum County, a significant number, 21.0%, of families are at or below the poverty level (Table 3.3).

Table 3.3. Poverty Status in 1999 (below poverty level)	Petroleum County	
	Number	Percent
Families	**29**	**(X)**
Percent below poverty level	(X)	21.0
With related children under 18 years	21	(X)
Percent below poverty level	(X)	28.8
With related children under 5 years	8	(X)
Percent below poverty level	(X)	27.6
Families with female householder, no husband present	**7**	**(X)**
Percent below poverty level	(X)	50.0
With related children under 18 years	7	(X)
Percent below poverty level	(X)	58.3
With related children under 5 years	2	(X)
Percent below poverty level	(X)	100.0
Individuals	**114**	**(X)**
Percent below poverty level	(X)	23.2
18 years and over	82	(X)
Percent below poverty level	(X)	22.4
65 years and over	14	(X)
Percent below poverty level	(X)	17.3
Related children under 18 years	32	(X)
Percent below poverty level	(X)	25.6
Related children 5 to 17 years	21	(X)
Percent below poverty level	(X)	23.1
Unrelated individuals 15 years and over	29	(X)
Percent below poverty level	(X)	34.5

(Census 2000)

The unemployment rate was 1.3% in Petroleum County in 1999, compared to 4.4% nationally during the same period. Approximately 25% of the Petroleum County employed population

worked in natural resources, with much of the indirect employment relying on the employment created through these natural resource occupations; Table 3.4 (Census 2000).

Table 3.4. Employment & Industry	Petroleum County	
	Number	Percent
Employed civilian population 16 years and over	**84**	**100.0**
OCCUPATION		
Management, professional, and related occupations	34	40.5
Service occupations	14	16.7
Sales and office occupations	9	10.7
Farming, fishing, and forestry occupations	6	7.1
Construction, extraction, and maintenance occupations	18	21.4
Production, transportation, and material moving occupations	3	3.6
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	21	25.0
Construction	6	7.1
Manufacturing	0	0.0
Wholesale trade	0	0.0
Retail trade	4	4.8
Transportation and warehousing, and utilities	6	7.1
Information	5	6.0
Finance, insurance, real estate, and rental and leasing	0	0.0
Professional, scientific, management, administrative, and waste management services	0	0.0
Educational, health and social services	17	20.2
Arts, entertainment, recreation, accommodation and food services	6	7.1
Other services (except public administration)	6	7.1
Public administration	13	15.5

Approximately 35% of Petroleum County's employed persons are private wage and salary workers, while around 27% are government workers (Table 3.5).

Table 3.5. Class of Worker	Petroleum County	
	Number	Percent
Private wage and salary workers	81	34.9
Government workers	62	26.7
Self-employed workers in own not incorporated business	89	38.4
Unpaid family workers	0	0.0

(Census 2000)

3.4 Description of Petroleum County

Petroleum County encompasses the 1,654 square miles of land to the south and west of the confluence of Mussellshell and Missouri Rivers. Winnett, the County Seat and only sizable community within the County, is centrally located at the junction of Highway 200 and 244. Large, expansive areas of undulating shortgrass prairie, dissected by forested coulees, towering

rimrock formations, broad floodplains, and badlands dominate the landscape of Petroleum County. The diversity in landscape provides habitat for a number of rangeland and forest plant species, as well as providing opportunities for agricultural crop production.

At the north end of Petroleum County lays the 1.1 million acre Charles M. Russell National Wildlife Refuge along the Missouri River. Much of the Refuge remains relatively unchanged from the historic voyage of Lewis and Clark. The Refuge contains examples of most landforms and vegetative communities found throughout the county, including spectacular examples of native prairie, forested coulees, river bottoms, and "breaks" badlands. Elk, mule deer, white-tailed deer, pronghorn, bighorn sheep, sage and sharp-tailed grouse, and bald eagles make the Refuge home.

Also managed within the CMR Complex is the War Horse National Wildlife Refuge. The Warhorse NWR consists of three separate upland units near Winnett, Montana. These units consist of scattered FWS landholdings adjacent to Wild Horse Lake and the Warhorse and Yellow Water reservoirs, which are managed primarily for migratory birds.

To the east, the Musselshell River serves as the border between Petroleum and Garfield and Rosebud Counties. The flood plain along the river supports extensive cottonwood forests that serve as home to a variety of wildlife species. The bottomlands also provide fertile soils for agricultural production in areas. The small creeks and coulees feeding the Musselshell are home to forested savannahs dominated by ponderosa pine and Rocky Mountain juniper.

The south and west county boundary follows public land survey section lines. Lands in these areas are characterized by range and farmlands, with isolated stringers of ponderosa pine along drainage bottoms.

Land ownership throughout the County is a mix of private, state, BLM and U.S. Fish and Wildlife Service. Much of the land in Petroleum County is managed in support of the ranching and agricultural economy of the area. Domestic livestock and wildlife graze many of the areas that are not actively cultivated for hay or other crops.

3.4.1 Highways

The main highways weaving through the county are State Highways 200 and 244. Highway 200 is the primary east-west transportation route through central Montana. Highway 244 is the sole paved route connecting Petroleum County to commercial centers to the south. Both of these two-lane highways are generally bordered by rangelands. Recreational and large truck traffic is particularly intense during the summer and fall months.

3.4.2 Climate

Petroleum County is usually warm in summer and has frequent hot days. In winter, periods of very cold weather occur when arctic air moves in from the north or northeast. Most precipitation falls as rain during the warmer part of the year. During summer in some years, hailstorms cause severe local damage to crops in the area. Seventy-five percent of the annual precipitation falls in April through September, which includes the growing season for most crops. The prevailing wind is from the southwest.

3.4.3 Rivers

The Musselshell River forms the eastern border of Petroleum County, while Fort Peck Reservoir on the Missouri River defines the northern boundary. During the historic times and still today, these waterways served as a large financial entity in Petroleum County providing many recreational and economic resources. Other important bodies of water in the county are Petrolia

Lake, Yellow Water Reservoir, War Horse Lake, Wild Horse Lake, and a plethora of streams that make ranching and agricultural production possible.

3.4.4 Recreation

Petroleum County has many outstanding fishing and hunting opportunities. The Charles M. Russell Wildlife Refuge is open to the public for boating, camping, wildlife viewing, and picnicking; however, developed sites within Petroleum County are limited. Sport fishing and big game, upland bird, and waterfowl hunting are enjoyed not only on the Refuge, but throughout the County.

The economic impacts of these activities to the local economy and the economy of Montana have not been enumerated.

3.4.4.1 Charles M. Russell Wildlife Refuge

Located in Central Montana, CMR is a 1.1 million acre refuge that contains native prairies, forested coulees, river bottoms, badlands and the 250,000 acre Fort Peck Reservoir. The refuge hosts more than 236 species of birds as well as elk, mule and white-tailed deer, antelope, bighorn sheep and prairie dogs. The double-crested cormorant and great blue heron nest on islands and in flooded timberland along the Fort Peck Reservoir. Many species of predatory birds including prairie falcons, golden eagles, osprey and American kestrels also nest on the refuge. Visitors enjoy hiking, horseback riding, bird and big-game hunting in designated areas on the refuge. Water activities include fishing, canoeing and, when conditions permit, ice fishing.

The refuge has a long history of wildlife/grazing conflicts since its inception by Executive Order in 1936. Prior to 1976, the refuge was jointly administered by the FWS and Bureau of Land Management. Dual management by agencies with differing mandates functioned poorly and in 1976 the FWS received full management authority with the passage of the "Game Range" bill.

3.4.4.2 Fishing and Hunting

Fishing and hunting is very important to Petroleum County both from a recreational standpoint and as an economic resource. Anglers often take catfish, walleye, northern pike, sauger, perch, bullhead, paddlefish, and lake trout from the waters of Fort Peck Lake.

For those people who prefer a gun or bow to a rod, Petroleum County offers a bounty of hunting experiences. Wild birds and game, like deer, antelope, elk, mountain lion, coyote, pheasant, quail, partridge, chukar, grouse, wild duck, geese, and doves are found in abundance.

3.4.5 Resource Dependency

Over the past century, employment through agricultural farming and livestock ranching has been significant in the region. Livestock ranching has been and continues to be an important component of the economy in Petroleum County. Livestock grazing in Petroleum and surrounding Counties has provided stable employment while serving to keep rangelands and forestlands alike maintained at a lower wildfire risk than if they had not been present and managed.

The role of natural resources in the local economies of Montana can be summarized by looking at the share of each community’s economic base. Basic industries, or export industries, consist of firms that sell their products outside the local area or that are otherwise affected by events outside the local area.

Basic industries are responsible for injecting new funds into a region's economy, which in turn create additional jobs and incomes as these dollars are spent and re-spent locally. The incomes earned by workers in basic industries are spent at local grocery stores, car dealerships, and healthcare facilities such as hospitals and doctors and dentist offices (sometimes denoted as derivative or secondary industries). The relationship between basic and derivative industries is often summarized in terms of a "multiplier," which reflects the amount of additional income (or jobs) created in derivative industries for each dollar (or job) increase in the basic industries (Polzin 1998).

Table 3.6. Gross state product in basic industries, 1994.

Industry	Millions of 2004$
Ag and Ag Service	$1,242
Mining	$1,128
Primary Manufacturing	$731
Subtotal of Natural Resources	$3,101
Natural resources / Basic	41.8%
Other Basic Industries	$4,317
Total Basic	$7,417

Source: (Polzin 1998)

Montana's economy is a natural resource dependent economy (Table 3.6), which in turn is affected by natural and man caused disasters, including wildland fire. Efforts to mitigate hazards will have a positive impact on both rural economies, but also on the state's economy.

3.5 Emergency Services & Planning and Zoning

The Petroleum County Commissioners have adopted the official Road Name List. Road signs have been installed throughout the County, including names and mileage to homes. These serve emergency response efforts well.

Currently, the County does not have Enhanced 911. The Fergus County Sheriff's office operates the 911 Dispatch Center for Petroleum County. In addition to handling law enforcement and emergency medical calls, the center also provides dispatch services to all of the rural fire districts and city fire departments in Fergus and Judith Basin Counties, and the fire company in Petroleum County. The dispatch center, operational 24 hours a day, is located in the Sheriff's office at 121 8th Avenue South in Lewistown, Montana.

With regards to wildfires, the 911 dispatch center is primarily responsible for receiving reports of fires and notifying the appropriate fire district and/or agency according to protocol sheets provided by the districts or agencies. The center will provide some support to incidents, but generally does not function as an expanded dispatch office. For large-scale incidents, the County Emergency Operations Center in the basement of the Sheriff Complex is activated. The county DES Coordinator will be involved in establishing and operating the EOC.

3.6 Cultural Resources

Cultural resource impacts were qualitatively assessed through a presence/absence determination of significant cultural resources and mitigation measures to be employed during potential fire mitigation activities such as thinning and prescribed fire.

The United States has a unique legal relationship with Indian tribal governments defined in history, the U.S. Constitution, treaties, statutes, Executive Orders, and court decisions. Since the formation of the union, the United States has recognized Indian tribes as domestic

dependant nations under its protection. The Federal Government has enacted numerous regulations that establish and define a trust relationship with Indian tribes.

The relationship between Federal agencies and sovereign tribes is defined by several laws and regulations addressing the requirement of Federal agencies to notify or consult with Native American groups or otherwise consider their interests when planning and implementing Federal undertakings, among these are:

- **EO 13175, November 6, 2000**, Consultation and Coordination with Indian Tribal Governments.
- **Presidential Memorandum, April, 1994**. Government-Government Relations with Tribal Governments (Supplements EO 13175). Agencies must consult with federally recognized tribes in the development of Federal Policies that have tribal implications.
- **EO 13007, Sacred sites, May 24, 1996**. Requires that in managing Federal lands, agencies must accommodate access and ceremonial use of sacred sites and must avoid adversely affecting the physical integrity of these sites.
- **EO 12875, Enhancing Intergovernmental Partnerships, October 26, 1993**. Mainly concerned with unfunded mandates caused by agency regulations. Also states the intention of establishing "regular and meaningful consultation and collaboration with state, local and tribal governments on matters that significantly or uniquely affect their communities."
- **Native American Graves Protection and Repatriation Act (NAGPRA) of 1989**. Specifies that an agency must take reasonable steps to determine whether a planned activity may result in the excavation of human remains, funerary objects, sacred objects and items of cultural patrimony from Federal lands. NAGPRA also has specified requirements for notifying and consulting tribes.
- **Archaeological Resources Protection Act (ARPA), 1979**. Requires that Federal permits be obtained before cultural resource investigations begin on Federal land. It also requires that investigators consult with the appropriate Native American tribe prior to initiating archaeological studies on sites of Native American origin.
- **American Indian Religious Freedom Act (AIRFA), 1978**. Sets the policy of the US to protect and preserve for Native Americans their inherent rights of freedom to believe, express, and exercise the traditional religions of the American Indian . . . including, but not limited to access to sacred sites, use and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites.
- **National Environmental Policy Act (NEPA), 1969**. Lead agency shall invite participation of affected Federal, State, and local agencies and any affected Indian Tribe(s).
- **National Historic Preservation Act (NHPA), 1966**. Requires agencies to consult with Native American tribes if a proposed Federal action may affect properties to which they attach religious and cultural significance. (Bulletin 38 of the act, identification of TCPs, this can only be done by tribes.)
- Treaties (supreme law of the land) in which tribes were reserved certain rights for hunting, fishing and gathering and other stipulations of the treaty.
- Unsettled aboriginal title to the land, un-extinguished rights of tribes.

3.6.1 National Register of Historic Places

The National Park Service maintains the National Register of Historical Places as a repository of information on significant cultural locale. These may be buildings, roads or trails, places where historical events took place, or other noteworthy sites. The NPS has recorded sites in its database. These sites are summarized in Table 3.7.

Table 3.7. National Register of Historic Places in Petroleum County, Montana.

Item Number	Resource Name	Address	City	Listed	Multiple
1	Winnett School	Jct. Moulton Ave. and Rowley St.	Winnett	1995	Sullivan Construction, Wasmansdorff, Otto

(NRHP 2003)

Fire mitigation activities in and around historical sites have the potential to affect historic places. In all cases, the fire mitigation work will be intended to reduce the potential of damaging the site due to wildfire. Areas where ground disturbance will occur will need to be inventoried depending on the location. Such actions may include, but are not limited to, constructed firelines (handline, mechanical line, etc.), new roads to creeks to fill water tankers, mechanical treatments, etc. Only those burn acres that may impact cultural resources that are sensitive to burning (i.e., buildings, peeled bark trees, etc.) would be examined. Burns over lithic sites are not expected to have an impact on those sites, as long as the fire is of low intensity and short duration. Some areas with heavy vegetation may need to be examined after the burn to locate and record any cultural resources although this is expected to be minimal. Traditional Cultural Properties (TCPs) will also need to be identified. Potential impact to TCPs will depend on what values make the property important and will be assessed on an individual basis.

3.7 Transportation

Primary access to and from Petroleum County is provided by State Highway 200, a two-lane highway traversing the County from east to west. This route enters near Mosby, travels through Winnett, and exits approximately 1 mile west of the remnant town of Teigen. This access is the only paved route connecting the central regions of Petroleum and neighboring Counties. State Highway 244 is a paved, two lane route connecting Winnett to the more urban centers of Roundup and Billings to the south.

Secondary, gravel roads maintained by the County or private entities provide access to the adjoining areas within the county, including the remnant community of Flatwillow, the oil fields, recreation areas, and rural homes. A variety of trails and closed roads are to be found throughout the region. Many of these roads were originally built to facilitate agricultural or ranching activities. In most cases, these roads are adequate to facilitate firefighting equipment as they adhere to County Building Codes. County building codes for new developments should be adhered to closely to insure this tendency continues.

3.8 Vegetation & Climate

Vegetation in Petroleum County is a mix of grasslands, rangelands, and forested ecosystems. An evaluation of satellite imagery of the region provides some insight to the composition of the forest vegetation of the area. The full extent of the county was evaluated for cover type as determined from Landsat 7 ETM+ imagery in tabular format, Table 3.8.

The most represented vegetated cover type is a Low/Moderate Cover Grasslands type at approximately 36% of the County's total area. The next most common vegetation cover type represented is a Xeric Shrub-Grassland Association at 12% of the total area. Dryland Agricultural represents only 7% of Petroleum County (Table 3.8).

Table 3.8. Cover Types in Petroleum County	Acres	Percent of County's Total Area
Low/Moderate Cover Grasslands	383,388	35.8%
Xeric Shrub-Grassland Associations	124,232	11.6%
Sagebrush	91,263	8.5%
Moderate/High Cover Grasslands	86,295	8.1%
Agricultural Lands: Dry	72,358	6.8%
Mixed Xeric Shrubs	60,441	5.7%
Ponderosa Pine	47,895	4.5%
Badlands	29,333	2.7%
Very Low Cover Grasslands	21,815	2.0%
Agricultural Lands: Irrigated	21,703	2.0%
Missouri Breaks	21,693	2.0%
Mixed Xeric Forest	18,182	1.7%
Low Density Xeric Forest	17,464	1.6%
Mesic Shrub-Grassland Associations	14,583	1.4%
Other Grasslands	12,093	1.1%
Altered Herbaceous	8,727	0.8%
Graminoid and Forb Riparian	7,268	0.7%
Silver Sage	6,837	0.6%
Shrub Riparian	6,417	0.6%
Water	6,105	0.6%
Mixed Broadleaf Forest	3,032	0.3%
Broadleaf Riparian	2,900	0.3%
Salt-Desert Shrub/Dry Salt Flat	1,471	0.1%
Mixed Barren Sites	1,347	0.1%
Rocky Mountain Juniper	1,007	0.1%
Mixed Riparian	743	0.1%
Conifer Riparian	566	0.1%
Urban or Developed Lands	218	0.0%
Douglas-fir	108	0.0%
Mixed Broadleaf and Conifer Riperian	56	0.0%
Mixed Broadleaf and Conifer Forest	18	0.0%

Vegetative communities within the county follow the strong moisture and temperature gradient related to the major river drainages. Scarce precipitation and soil conditions result in a relatively arid environment. As moisture availability increases, so does the abundance of hardwood and conifer species.

3.8.1 Monthly Climate Summaries In or Near Petroleum County

3.8.1.1 Winnett, Montana (249047)

Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1948 to 10/31/1971

Table 3.9. Climate records for Winnett, Montana (Petroleum County)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	Insufficient Data												
Average Min. Temperature (F)	Insufficient Data												
Average Total Precipitation (in.)	0.66	0.42	0.48	1.15	2.23	2.42	1.63	1.12	0.99	0.68	0.41	0.46	12.64
Average Total SnowFall (in.)	10.8	6.4	6.9	7.6	1.4	0.3	0.0	0.0	0.2	2.9	3.2	7.0	46.7
Average Snow Depth (in.)	4	4	2	0	0	0	0	0	0	0	0	2	1

Percent of possible observations for period of record. Max. Temp.: 0% Min. Temp.: 0% Precipitation: 97.9% Snowfall: 93.8% Snow Depth: 94.1%

3.8.1.2 Flatwillow, Montana (243013)

Period of Record Monthly Climate Summary
Period of Record : 6/ 8/1913 to 3/31/2004

Table 3.10. Climate records for Flatwillow, Montana (Petroleum County)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.6	38.4	46.1	58.5	68.8	77.0	87.2	86.0	74.0	62.0	46.6	37.2	59.6
Average Min. Temperature (F)	9.1	13.4	20.4	30.5	39.5	47.9	53.6	51.4	42.3	33.0	21.3	12.5	31.2
Average Total Precipitation (in.)	0.41	0.33	0.64	1.03	2.29	2.79	1.40	1.10	1.03	0.85	0.43	0.44	12.74
Average Total SnowFall (in.)	6.6	5.2	6.9	4.1	0.9	0.1	0.0	0.0	0.5	2.7	4.7	6.9	38.7
Average Snow Depth (in.)	2	1	1	0	0	0	0	0	0	0	1	1	1

Percent of possible observations for period of record. Max. Temp.: 99% Min. Temp.: 99% Precipitation: 99.4% Snowfall: 98.8% Snow Depth: 55.2%.

3.9 Wildfire Hazard Profiles

3.9.1 Wildfire Ignition Profile

Fire was once an integral function of the majority of ecosystems in Montana. The seasonal cycling of fire across the landscape was as regular as the July, August and September lightning storms plying across the canyons and mountains. Depending on the plant community composition, structural configuration, and buildup of plant biomass, fire resulted from ignitions

with varying intensities and extent across the landscape. Shorter return intervals between fire events often resulted in less dramatic changes in plant composition (Johnson 1998). The fires burned from 1 to 47 years apart, with most at 5- to 20-year intervals (Barrett 1979). With infrequent return intervals, plant communities tended to burn more severely and be replaced by vegetation different in composition, structure, and age (Johnson *et al.* 1994). Native plant communities in this region developed under the influence of fire, and adaptations to fire are evident at the species, community, and ecosystem levels. Fire history data (from fire scars and charcoal deposits) suggest fire has played an important role in shaping the vegetation in the Columbia Basin for thousands of years (Steele *et al.* 1986, Agee 1993).

Detailed records of fire ignition and extent have been compiled by the USDA Forest Service, and the USDI Bureau of Land Management. Using this data on past fire extents and fire ignition data, the occurrence of wildland fires in the region of Petroleum County has been evaluated.

Many fires have burned in the region of Petroleum County (Table 3.11a, 3.11b & 3.12). Figure 3.1 summarizes fire ignitions and acres burned annually (1980-2003). There were approximately 214 fire ignitions during this 24 year period, with the highest number of total ignitions peaking in 1983 and 1996, and again during the past 5 years. However, the period 2000-2003 includes data provided by the Winnett Fire Department, in addition to the data provided by the BLM, therefore the period prior to 2000 may be under-represented in comparison with recent years (Figure 3.1).

The average number of acres burned each year since 1980 has been approximately 574 acres, with the average fire burning just under 80 acres after ignition.

Table 3.11a. Past fire ignitions in Petroleum County, Montana: 1980-2003 (USFS BLM).

Name	LATITUDE	LONGITUDE	Cause[1]	Acres	Year
TIMBER RD6	47.567	-108.300	1	0	1980
COTTONWOOD	47.133	-108.100	1	0	1980
E COTTONWD	47.133	-108.083	1	0	1980
TIMBER CAN	47.077	-108.558	1	3	1980
BEAR CAN	47.033	-108.431	1	3	1980
DAVIS PRON	46.983	-107.900	1	3	1980
DRAG RIDGE	47.383	-108.067	1	4	1980
ULBEND	47.467	-108.017	1	25	1980
CHAD	47.133	-108.033	1	27	1980
			0	35	1980
DOVETAIL	47.300	-108.050	1	2600	1980
SKYLINE	47.550	-108.183	1	1	1981
BLOOD CRK	47.233	-108.033	1	1	1981
WEINGART	47.250	-108.217	1	1	1981
DEER CREEK	47.383	-107.950	0	0	1982
NORTHBLOOD	47.267	-108.333	1	3	1982
CAT CREEK	47.200	-108.017	1	6	1982
TINCANHILL	47.200	-108.250	1	110	1982
FA 1	47.100	-108.467	0	0	1983
HORSE CAMP	47.200	-108.317	1	0	1983
DRAG RES	47.283	-108.150	1	0	1983
BLOOD CK	47.233	-108.167	1	1	1983
SCADAWEA	47.483	-108.200	1	1	1983

Table 3.11a. Past fire ignitions in Petroleum County, Montana: 1980-2003 (USFS BLM).

Name	LATITUDE	LONGITUDE	Cause[1]	Acres	Year
POKER	47.167	-108.167	1	2	1983
HORSE CAMP	47.433	-108.200	1	2	1983
BOAT RAMP	47.483	-108.100	1	5	1983
RANCHER	47.217	-108.267	1	5	1983
TEIGEN	47.017	-108.600	1	5	1983
DRAG CREEK	47.317	-108.117	1	10	1983
DUNN RIDGE	47.267	-108.467	1	10	1983
BARROW S65	47.483	-108.050	1	15	1983
MARTY	47.183	-108.250	1	20	1983
BIGGETT C	47.200	-108.167	1	40	1983
GARDNER	47.200	-108.250	1	250	1983
CHAIN BTE	47.533	-108.033	1	1365	1983
SODA CREEK	47.500	-108.000	0	0	1984
FA 1	47.283	-108.083	0	0	1984
FA 4	46.800	-108.250	0	0	1984
DRAG RIDGE	47.433	-108.100	1	1	1984
LOST CK	47.550	-107.950	1	1	1984
LOST CK 2	47.567	-107.967	1	1	1984
LOST CK 1	47.567	-107.983	1	1	1984
SAGE HEN	47.083	-107.933	1	2	1984
TIN CAN H	47.167	-108.167	1	5	1984
WEAVER	47.417	-108.250	1	5	1984
SODA CREEK	47.550	-107.950	1	0	1985
79 TRAIL	47.317	-108.000	1	0	1985
DUNN RIDGE	47.300	-108.250	1	1	1985
BLOOK CRK	47.178	-107.964	1	1	1985
CHAIN BUTE	47.567	-108.067	1	5	1985
SODA CREEK	47.550	-108.033	1	20	1985
FA 1	47.250	-108.000	0	0	1986
SQUAW CK	47.450	-108.167	1	20	1986
MAY DAY	47.100	-108.683	1	1	1987
HENRY CAB	47.560	-108.000	1	3	1987
WAR HORSE	47.100	-108.550	0	30	1987
WAR HORSE	47.100	-108.550	9	75	1987
DRAG	47.483	-108.167	1	0	1988
DRAG RIDGE	47.400	-108.083	1	0	1988
SODA CREEK	47.500	-107.967	1	2	1988
TINCANHILL	47.200	-108.117	1	3	1988
THOMPSON	47.433	-108.250	1	4	1988
DEERCOULEE	47.400	-107.933	1	5	1988
DEER COUL	47.400	-107.930	1	5	1988
SODA CREEK	47.500	-107.960	1	5	1988
NORTH TIN	47.200	-108.233	1	15	1988
OLYMPIA	47.217	-108.133	1	20	1988

Table 3.11a. Past fire ignitions in Petroleum County, Montana: 1980-2003 (USFS BLM).

Name	LATITUDE	LONGITUDE	Cause[1]	Acres	Year
YELLOW WTR	47.000	-108.567	1	50	1988
MARTY FIRE	47.167	-108.233	1	2	1989
BATTLE PON	47.100	-108.600	1	5	1989
FALSEALRM5	47.333	-107.967	0	0	1990
	47.510	-108.050	1	0	1990
BARROW SPR	47.400	-108.100	1	1	1990
SODA CREEK	47.533	-107.983	1	1	1990
	47.530	-107.980	1	1	1990
ARMELL CRK	47.350	-108.183	1	2	1990
DRAG CREEK	47.383	-108.133	1	5	1990
CAMEL BRAT	47.217	-108.250	1	5	1990
CROOKEDCRK	47.333	-108.050	1	6	1990
DUNN RIDGE	47.267	-108.217	1	15	1990
WILLIAMS G	47.133	-108.083	1	70	1990
GRAMMRUDMN	47.367	-108.017	1	300	1990
DUNN RIDGE	47.283	-108.133	1	25	1991
BIG COULEE	47.350	-108.283	1	25	1991
79 TRAIL	47.317	-107.983	1	2700	1991
FROG FIRE	47.567	-108.017	1	2	1992
THOMPSONCL	47.417	-108.217	1	3	1992
MUD	47.533	-108.267	1	3	1992
FA-1	47.267	-108.133	0	0	1994
SMALLFRY	47.517	-108.067	1	0	1994
CROOKED	47.467	-108.117	1	0	1994
EAGLE EYE	47.560	-108.160	1	0	1994
EAST CHAIN	47.517	-108.017	1	1	1994
LARRY	47.517	-108.100	1	2	1994
FINAL	47.300	-108.017	1	2	1994
79 TRAIL	47.350	-108.117	1	25	1994
BARREL SPR	47.433	-108.067	1	36	1994
WARHORSE	47.117	-108.483	1	50	1994
S CHAINBTE	47.517	-108.033	1	259	1994
KELLY SITE	46.767	-108.183	1	400	1994
FA 2	47.097	-108.433	0	0	1995
FA 9	47.236	-108.123	0	0	1995
FA 6	47.266	-108.294	0	0	1995
ASSIST #7	47.260	-108.290	0	0	1995
TIN CAN	47.379	-108.037	1	0	1995
TEIGEN	47.019	-108.558	1	1	1995
YUCA	47.279	-108.081	1	2	1995
PETRO 1	47.283	-108.283	4	7	1995
BEE	47.509	-108.061	1	10	1995
ALKALICRK	47.360	-107.960	1	10	1995
79 FIRE	47.322	-108.081	1	40	1995

Table 3.11a. Past fire ignitions in Petroleum County, Montana: 1980-2003 (USFS BLM).

Name	LATITUDE	LONGITUDE	Cause[1]	Acres	Year
BLOODCREEK	47.206	-108.251	1	80	1995
LOWER DUNN	47.279	-108.102	1	757	1995
FA 8	47.500	-108.000	0	0	1996
HOTCARLTON	47.233	-108.450	1	1	1996
RURAL	47.106	-108.007	1	2	1996
HALEY	47.164	-108.054	1	2	1996
CHAMBERLIN	47.163	-108.049	1	6	1996
CARL'SCAMP	47.467	-108.167	1	7	1996
BRATTEN	47.149	-108.261	1	10	1996
ALKALI	47.307	-107.974	1	12	1996
Petroleum County	0.000	0.000	0	13	1996
BUTTONBTTE	47.000	-108.000	1	15	1996
CHAINBUTTE	47.533	-108.083	1	180	1996
LAKE CREEK	47.117	-108.550	2	210	1996
HAY COULEE	47.500	-108.133	1	250	1996
HORSECAMP	47.483	-108.200	1	350	1996
DOVETAIL	47.233	-107.967	6	550	1996
NON	47.451	-107.956	0	0	1997
HILL	47.206	-108.230	1	5	1997
TWO CROW	47.337	-108.144	1	10	1997
CAN	47.178	-108.240	1	13	1997
COW	47.191	-108.230	1	35	1997
MISSOURI	47.525	-108.283	0	0	1998
THE SPOT	47.525	-108.283	0	0	1998
F A #5	47.423	-108.187	0	0	1998
SODA CR	47.538	-107.960	0	0	1998
STRAWBALE	46.970	-108.113	1	0	1998
CROOKED CR	47.451	-107.973	1	2	1998
Dunn	47.293	-108.187	1	1	1999
377	47.480	-107.990	1	5	1999
Barrel	47.409	-108.081	1	21	1999
Haley	47.177	-108.072	1	35	1999
NO 8	47.062	-108.007	1	40	1999
WARHORSE	47.110	-108.500	1	75	1999
Cat Creek	47.062	-108.007	1	160	1999
Tin	47.236	-108.102	1	550	1999
ASSIST 1	47.200	-108.070	1	650	1999
FWS 11	47.567	-108.267	0	0	2000
FWS 10	47.400	-107.967	0	0	2000
FWS ASST6	47.567	-108.302	0	0	2000
Sacajawea	47.484	-108.162	1	0	2000
Marty	47.209	-108.220	1	1	2000
ANTELOPE S	47.183	-108.159	1	1	2000
Musselshel	47.218	-107.981	1	5	2000

Table 3.11a. Past fire ignitions in Petroleum County, Montana: 1980-2003 (USFS BLM).

Name	LATITUDE	LONGITUDE	Cause[1]	Acres	Year
Blood	47.440	-108.096	1	525	2000
Petroleum	47.333	-108.302	1	0	2001
Double S	47.014	-108.585	1	0	2001
Cimmarron	47.482	-108.116	1	1	2001
	47.320	-108.200	0	12	2001
GibbsCoule	47.307	-108.059	1	15	2001
State	47.366	-108.165	1	20	2001
HOWARDCOUL	46.765	-108.415	1	57	2001
Lewis	47.115	-108.719	1	0	2002
Sblack but	47.209	-108.566	1	0	2002
Drag	47.379	-108.082	1	1	2002
Dovetail	47.323	-108.049	1	3	2002
Dry Coulee	47.581	-108.067	1	4	2002
Gill Feath	47.165	-107.965	1	4	2002
Cottonwood	47.154	-108.076	1	13	2002
Browning	47.221	-107.996	1	25	2002
POST 1	47.250	-108.167	2	96	2002
BARREL SPRINGS			0	16	2003
TIN CAN			0	93	2003

[1] See table 3.12 for cause codes.

Table 3.11b. Past fire ignitions in Petroleum County, Montana: 2000-2003 (Winnett Fire Department).

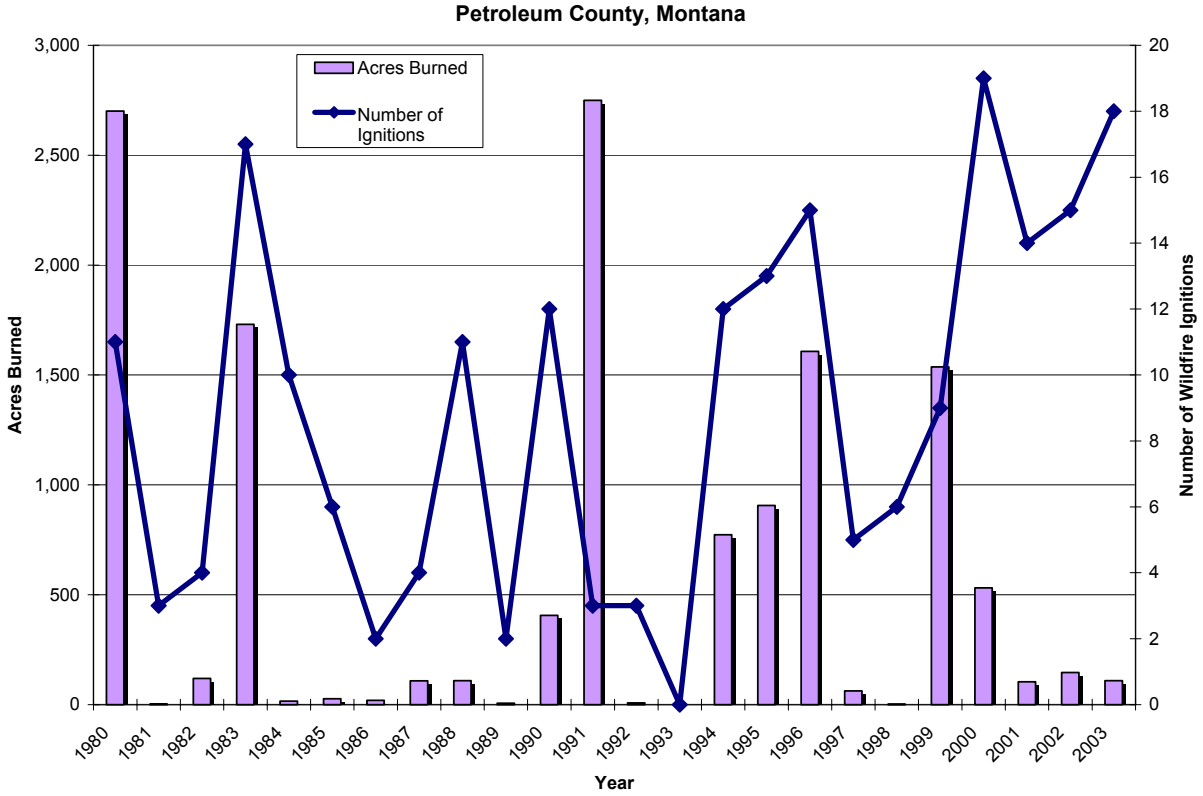
Name	Location	Cause[1]	Acres	Year
MOORE	At Residence	0	0.5	2000
VEH	HWY 200 W MP 119	Brake (9)	0	2000
POULTON	.5 mile N of 37 Petrolis Bench Rd	Electric (9)	0.5	2000
FLATWILLOW	Hwy 87 N MP 25	0 (9)	0.5	2000
HAYSTACK	2 miles south Winnett	1	0.25	2000
BOHN	1 mile south of 79 Bohn Ranch Road	1	220	2000
BUSENBARK	1020 Valentine Road	Electric (9)	0.5	2000
SHAW	¼ mile east Moss. River Hwy 200 E MP 159	6	4	2000
BOHN	79 Bohn Ranch Road	1	0.5	2000
ALEX CAMP	North of Alex Camp	2	25	2000
RAY HALE	Slash Pile	4	0.25	2000
DELANEY	813 Welter Divide Rd	6	200	2001
VEH	Hwy 2445 MP 25	6	0	2001
BUNKHOUSE	13774 Hwy 200	uu (9)	0	2001
FIRE #1	79 Trail Rd	1	45	2001
FIRE #2	79 Trail Rd	1	25	2001
TEIGEN	2334 Hwy 200	1	0.5	2001
LEWIS	1130 Welter Divide Rd	4	0.5	2001
BARRELL SPRINGS	19N 38E 25	1	4	2002
TREE	79 Bohn Ranch Rd	1	0	2002

Table 3.11b. Past fire ignitions in Petroleum County, Montana: 2000-2003 (Winnett Fire Department).

Name	Location	Cause[1]	Acres	Year
TRAILOR HOUSE	1130 Welter Divide Rd	1	0	2002
GARDNER	16N 27E 21	1	1	2002
GILFEATHER	16N 30E 6	1	4.5	2002
VEH	Hwy 200 E MP 152	Rollover (9)	0	2002
BRADY	100 EB Ranch Rd	EMS (9)	0	2003
NUNN SHOP	60 Wildhorse Rd	Elec (9)	0	2003
VEH 2	244	0 (9)	0	2003
DICK GIBSON	2560 Lower River Rd	4	0.10	2003
BARRELL SPRINGS	Lat 47.23 Long 108.04	2	1.5	2003
HWY 200	Hwy 200 W MP 132.3	6	1	2003
JENSEN	Valentine Rd17N 26E 5	1	1.5	2003
PETROLIA RESERVOIR	14N 27E 36	1	0.1	2003
TIN CAN HILL	17N 29E 24	1	35	2003
BARRELL SPRINGS	Lat 47.24 Long 108.06	1	45	2003
FLEAHEARTY	Lat 47.11 Long 108.38	1	240	2003
ALKILY CREEK	19N 39E 35	1	35	2003
NO BATTER FIRE	Lat 47.15 Long 108.10	1	50	2003
TOBY MUTUAL AID	Lat 46.44 Long 108.37	6	600	2003
HORSE CAMP	Lat 47.25 Long 108.11	3	3	2003
MOORE	Lat 47.00 Long 108.09	4	0.5	2003

[1] See table 3.12 for cause codes.

Figure 3.1. Petroleum County Wildfire Ignition and Extent Profile.



Since 1980, it would appear that roughly 75% of all fires in the County have been ignited by nature, while the remaining 25%, on average have been human caused (including miscellaneous causes, Tables 3.11a & 3.11b). In comparison with the rest of Montana and the Western United States, this statistic would indicate that the rate of human caused ignitions is below the average experienced elsewhere, where human caused ignitions often climb above 25% and even 35%. There may be many factors contributing to this statistic, but the low population of the county, coupled with the agrarian economy and wildfire educated residents are all positive factors.

Table 3.12. Wildfire Ignitions by Cause in Petroleum County by cause.

Cause	Cause Reference	1980-2003 Occurrence	Percent
Lightning	1	160	75.1%
Campfire	2	4	1.9%
Smoking	3	1	0.5%
Debris Burning	4	5	2.3%
Arson	5	0	0.0%
Equipment Use	6	6	2.8%
Railroad	7	0	0.0%
Children	8	0	0.0%
Miscellaneous	9	10	17.4%
Total		**213**	

[1] *Data provided by the Bureau of Land Management & the Winnett Fire Department.*

3.9.2 Regional Wildfire Profile

Across the west, wildfires have been increasing in extent and cost of control. The National Interagency Fire Center (2003) reports nearly 88,500 wildfires in 2002 burned a total of nearly 7 million acres and cost $1.6 billion (Table 3.13). By most informed accounts, the 2003 totals will be significantly higher in terms of acres burned and cost.

Table 3.13. National Fire Season 2002 Summary

Number of Fires (2002 final)	88,458
10-year Average (1992-2001)	103,112
Acres Burned (2002 final)	*** 6,937,584**
10-year Average (1992-2001)	4,215,089
Structures Burned (835 primary residences, 46 Commercial buildings, 1500 outbuildings)	2,381
Estimated Cost of Fire Suppression (Federal agencies only)	$ 1.6 billion

- *This figure differs from the 7,184,712 acres burned estimate provided by the National Interagency Coordination Center (NICC). The NICC estimate is based on information contained in geographic area and incident situation reports prepared at the time fires occurred. The 6,937,584 estimate is based on agency end-of-year reports.*

The National Interagency Fire Center, located in Boise, Idaho, maintains records of fire costs, extent, and related data for the entire nation. Tables 3.14 and 3.15 summarize some of the relevant wildland fire data for the nation, and some trends that are likely to continue into the future unless targeted fire mitigation efforts are implemented and maintained in areas like Petroleum County.

Table 3.14. Total Fires and Acres 1960 - 2002 Nationally

These figures are based on end-of-year reports compiled by all wildland fire agencies after each fire season, and are updated by March of each year. The agencies include: Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service, USDA Forest Service and all State Lands.

Year	Fires	Acres	Year	Fires	Acres
2002	88,458	* **6,937,584**	1980	234,892	5,260,825
2001	84,079	3,555,138	1979	163,196	2,986,826
2000	122,827	8,422,237	1978	218,842	3,910,913
1999	93,702	5,661,976	1977	173,998	3,152,644
1998	81,043	2,329,709	1976	241,699	5,109,926
1997	89,517	3,672,616	1975	134,872	1,791,327
1996	115,025	6,701,390	1974	145,868	2,879,095
1995	130,019	2,315,730	1973	117,957	1,915,273
1994	114,049	4,724,014	1972	124,554	2,641,166
1993	97,031	2,310,420	1971	108,398	4,278,472
1992	103,830	2,457,665	1970	121,736	3,278,565
1991	116,953	2,237,714	1969	113,351	6,689,081
1990	122,763	5,452,874	1968	125,371	4,231,996
1989	121,714	3,261,732	1967	125,025	4,658,586
1988	154,573	7,398,889	1966	122,500	4,574,389
1987	143,877	4,152,575	1965	113,684	2,652,112
1986	139,980	3,308,133	1964	116,358	4,197,309
1985	133,840	4,434,748	1963	164,183	7,120,768
1984	118,636	2,266,134	1962	115,345	4,078,894
1983	161,649	5,080,553	1961	98,517	3,036,219
1982	174,755	2,382,036	1960	103,387	4,478,188
1981	249,370	4,814,206			

(National Interagency Fire Center 2003)

Table 3.15. Suppression Costs for Federal Agencies Nationally

Year	Bureau of Land Management	Bureau of Indian Affairs	Fish and Wildlife Service	National Park Service	USDA Forest Service	Totals
1994	$98,417,000	$49,202,000	$3,281,000	$16,362,000	$678,000,000	**$845,262,000**
1995	$56,600,000	$36,219,000	$1,675,000	$21,256,000	$224,300,000	**$340,050,000**
1996	$96,854,000	$40,779,000	$2,600	$19,832,000	$521,700,000	**$679,167,600**
1997	$62,470,000	$30,916,000	$2,000	$6,844,000	$155,768,000	**$256,000,000**
1998	$63,177,000	$27,366,000	$3,800,000	$19,183,000	$215,000,000	**$328,526,000**
1999	$85,724,000	$42,183,000	$4,500,000	$30,061,000	$361,000,000	**$523,468,000**
2000	$180,567,000	$93,042,000	$9,417,000	$53,341,000	$1,026,000,000	**$1,362,367,000**
2001	$192,115,00	$63,200,000	$7,160,000	$48,092,000	$607,233,000	**$917,800,000**
2002	$204,666,000	$109,035,000	$15,245,000	$66,094,000	$1,266,274,000	**$1,661,314,000**

(National Interagency Fire Center 2003)

Although many very large fires, growing to over 250,000 acres have burned in Montana actual fires in this county have usually been controlled at much smaller extents. This is not to imply that wildfires are not a concern in this county, but to point to the aggressive and professional manner to which the wildland and rural fire districts cooperate in controlling these blazes. The Petroleum County Rural Fire District provides primary wildfire protection in Petroleum County in cooperation with the Bureau of Land Management with the Montana Department of Natural Resources and Conservation assisting for wildfires that escape initial attack.

3.10 Analysis Tools and Techniques to Assess Fire Risk

Petroleum County and the adjacent counties of Fergus and Judith Basin Counties, were analyzed using a variety of techniques, managed on a GIS system (ArcGIS 8.2). Physical features of the region were represented by data layers including roads, streams, soils, elevation, and remotely sensed images from the Landsat 7 ETM+ satellite. Field visits were conducted by specialists from Northwest Management, Inc., and others. Discussions with area residents and fire control specialists augmented field visits and provided insights to forest health issues and treatment options.

This information was analyzed and combined to develop an assessment of wildland fire risk in the region.

3.10.1 Fire Prone Landscapes

Schlosser *et al.* 2002, developed a methodology to assess the location of fire prone landscapes on forested and non-forested ecosystems in the western US. Working under an agreement with the Clearwater Resource Conservation and Development Council, Inc., (RC&D), Northwest Management, Inc., a natural resources consulting firm, completed a similar assessment for five counties in the north central Idaho area including Clearwater County, Idaho County, Latah County, Lewis County, and Nez Perce County. In a separate project, also funded by the Bureau

of Land Management working in cooperation with Adams, Gem, Payette, Washington, and Valley Counties, through the West Central Highlands RC&D Area, Northwest Management, Inc., completed a Fire Prone Landscapes assessments on those listed areas. Additional assessments of Fire Prone Landscapes were completed simultaneously for Ada, Boise, Canyon, and Elmore Counties, working in cooperation with the Southwestern Idaho RC&D located in Meridian, Idaho.

The goal of developing the Fire Prone Landscapes analysis is to make inferences about the relative risk factors across large geographical regions (multiple counties) for wildfire spread. This analysis uses the extent and occurrence of past fires as an indicator of characteristics for a specific area and their propensity to burn in the future. Concisely, if a certain combination of vegetation cover type, canopy closure, aspect, slope, stream and road density have burned with a high occurrence and frequently in the past, then it is reasonable to extrapolate that they will have the same tendency in the future, unless mitigation activities are conducted to reduce this potential.

The analysis for determining those landscapes prone to wildfire utilized a variety of sources.

Digital Elevation: Digital elevation models (DEM) for the project used USGS 30 meter DEM data provided at quarter-quadrangle extents. These were merged together to create a continuous elevation model of the analysis area.

The merged DEM file was used to create two derivative data layers; aspect and slope. Both were created using the spatial analyst extension in ArcGIS 8.2. Aspect data values retained one decimal point accuracy representing the cardinal direction of direct solar radiation, represented in degrees. Slope was recorded in percent and also retained one decimal point accuracy.

Remotely Sensed Images: Landsat 7 Enhanced Thematic Mapper (ETM+) images were used to assess plant cover information and percent of canopy cover. The Landsat ETM+ instrument is an eight-band multi-spectral scanning radiometer capable of providing high-resolution image information of the Earth's surface. It detects spectrally-filtered radiation at visible, near-infrared, short-wave, and thermal infrared frequency bands from the sun-lit Earth. Nominal ground sample distances or "pixel" sizes are 15 meters in the panchromatic band; 30 meters in the 6 visible, near and short-wave infrared bands; and 60 meters in the thermal infrared band.

The satellite orbits the Earth at an altitude of approximately 705 kilometers with a sun-synchronous 98-degree inclination and a descending equatorial crossing time of 10 a.m. daily.

Image spectrometry has great application for monitoring vegetation and biophysical characteristics. Vegetation reflectance often contains information on the vegetation chlorophyll absorption bands in the visible region and the near infrared region. Plant water absorption is easily identified in the middle infrared bands. In addition, exposed soil, rock, and non-vegetative surfaces are easily separated from vegetation through standard hyper-spectral analysis procedures.

Landsat 7 ETM images were obtained to conduct hyper-spectral analysis for this project. The image was obtained in 1998. Hyper-spectral analysis procedures followed the conventions used by the Montana Vegetation and Land Cover Classification System, modified from Redmond (1997) and Homer (1998).

Riparian Zones: Riparian zones were derived from stream layers.

Wind Direction: Wind direction and speed data detailed by monthly averages was used in this project to better ascertain certain fire behavior characteristics common to large fire events. These data are spatially gridded Average Monthly Wind Directions in Montana. The coverage

was created from data summarized from the Interior Columbia Basin Ecosystem Management Project (Quigley *et al.* 2001).

Past Fires: Past fire extents represent those locations on the landscape that have previously burned during a wildfire. Past fire extent maps were obtained from a variety of sources for the central Montana area, including databases provided by the US Forest Service and the Bureau of Land Management.

Fire Prone Landscapes: Using the methodology developed by Schlosser *et al.* (2002), and refined for this project, the factors detailed above were used to assess the potential for the landscape to burn during the fire season in the case of fire ignition. Specifically, the entire region was evaluated at a resolution of 30 meters (meaning each pixel on the screen represented a 30 meter square on the ground) to determine the propensity for a particular area (pixel) to burn in the case of a wildfire. The analysis involved creating a linear regression analysis within the GIS program structure to assign a value to each significant variable, pixel-by-pixel. The analysis ranked factors from 0 (little to no risk) to 100 (extremely high risk) based on past fire occurrence. In fact, the maximum rating score for Petroleum County was 88 with a low of 3.

This map is presented for reference in this section of the plan. This map, and additional maps are detailed in Appendix I.

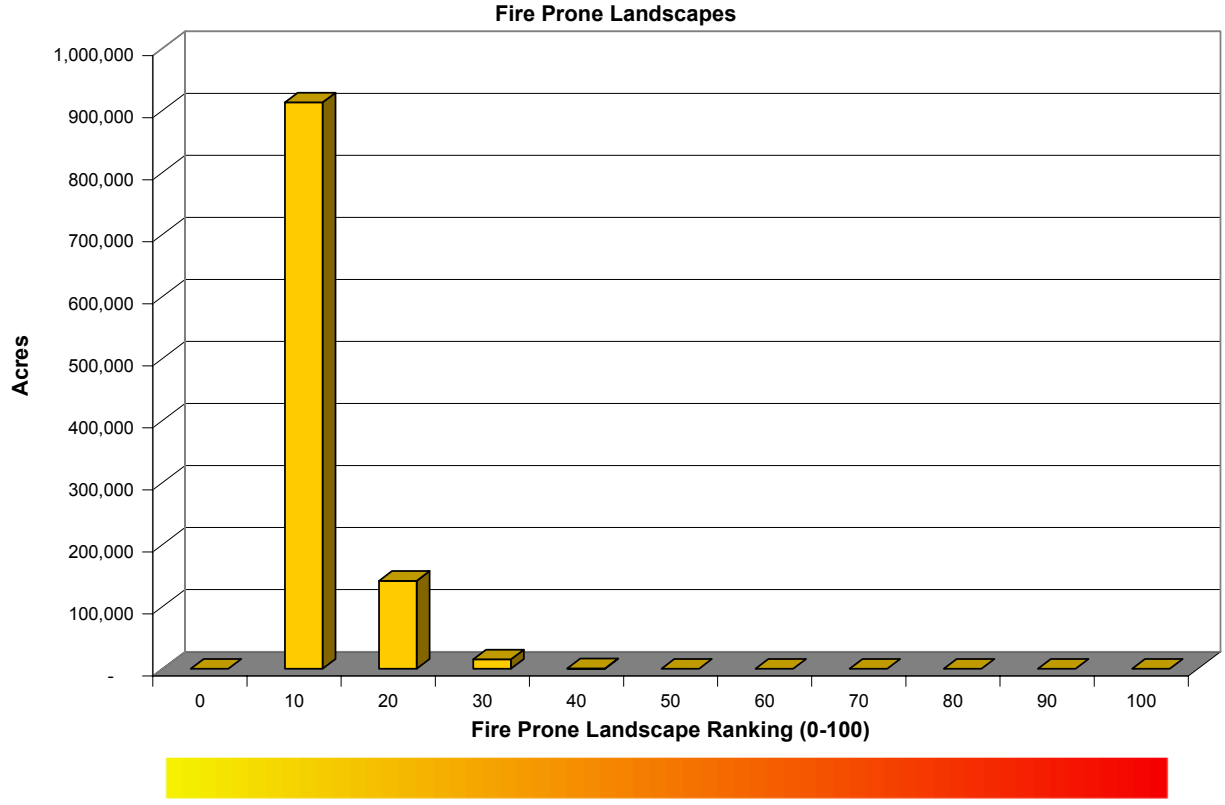
The maps depicting these risk categories display yellow as the lowest risk and red as the highest with values between a constant gradient from yellow to orange to red (Table 3.16).

While large maps (16 square feet) have been provided as part of this analysis, smaller size maps are presented in Appendix I.

Table 3.16. Fire Prone Landscape rankings and associated acres in each category for Petroleum County.

Color Code	Value	Total	Percent of Total Area
	0	-	0.0%
	10	912,871	85.3%
	20	141,764	13.2%
	30	14,854	1.4%
	40	586	0.1%
	50	25	0.0%
	60	-	0.0%
	70	-	0.0%
	80	2	0.0%
	90	8	0.0%
	100	-	0.0%

Figure 3.3: Distribution of area by Fire Prone Landscape Class.



The risk category values developed in this analysis should be considered **ordinal data**, that is, while the values presented have a meaningful ranking, they neither have a true zero point nor scale between numbers. Rating in the "40" range is not necessarily twice as "risky" as rating in the "20" range. These category values also do not correspond to a rate of fire spread, a fuel

loading indicator, or measurable potential fire intensity. Each of those scales is greatly influenced by weather, seasonal and daily variations in moisture (relative humidity), solar radiation, and other factors. The risk rating presented here serves to identify where certain constant variables are present, aiding in identifying where fires typically spread into the largest fires across the landscape.

3.10.2 Fire Regime Condition Class

The US Forest Service has provided their assessment of Fire Regime Condition Class Petroleum County to this WUI Fire Mitigation Plan analysis. These measures of forest conditions are the standard method of analysis for the USDA Forest Service.

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Coarse scale definitions for natural (historical) fire regimes have been developed by Hardy *et al.* (2001) and Schmidt *et al.* (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes include:

I – 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75% of the dominant overstory vegetation replaced);

II – 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

III – 35-100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced);

IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

V – 200+ year frequency and high (stand replacement) severity.

As scale of application becomes finer these five classes may be defined with more detail, or any one class may be split into finer classes, but the hierarchy to the coarse scale definitions should be retained.

A fire regime condition class (FRCC) is a classification of the amount of departure from the natural regime (Hann and Bunnell 2001). Coarse-scale FRCC classes have been defined and mapped by Hardy *et al.* (2001) and Schmidt *et al.* (2001) (FRCC). They include three condition classes for each fire regime. The classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g. insect and diseased mortality, grazing, and drought). There are no wildland vegetation and fuel conditions or wildland fire situations that do not fit within one of the three classes.

The three classes are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the natural (historical) regime (Hann and Bunnell 2001, Hardy *et al.* 2001, Schmidt *et al.* 2002). The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other

associated natural disturbances. Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside.

Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural (historical) fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural (historical) fire regime, such as invasive species (e.g. weeds, insects, and diseases), "high graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that will not carry a surface fire. Determination of the amount of departure is based on comparison of a composite measure of fire regime attributes (vegetation characteristics; fuel composition; fire frequency, severity and pattern) to the central tendency of the natural (historical) fire regime. The amount of departure is then classified to determine the fire regime condition class. A simplified description of the fire regime condition classes and associated potential risks are presented in Table 3.17. Maps depicting Fire Regime and Condition Class are presented in Appendix I.

Table 3.17. Fire Regime Condition Class Definitions.

Fire Regime Condition Class	Description	Potential Risks
Condition Class 1	Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) is low.
Condition Class 2	Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate. Risk of loss of key ecosystem components is moderate.
Condition Class 3	High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components is high.

This analysis of Petroleum county was completed while completing other counties in western Montana. Unfortunately, the majority of Petroleum County was not evaluated. Only 35% of the

county was analyzed. Of that area considered, the analysis of Fire Regime Condition Class in Petroleum County shows that approximately 31% of the County is in the category of a Moderate Departure in grasslands and shrublands, just about 20% is in Condition Class 2 (moderate departure), with the remaining area in Condition Class 3 (Table 3.18).

Table 3.18. FRCC by area in Petroleum County.

	Condition Class	Acres	Percent of Area
0	Not Assessed	703,991	65.8%
1	Low departure	6,230	0.6%
2	Moderate departure	591	0.1%
3	High departure	36	0.0%
4	Moderate grass/shrub	330,609	30.9%
8	Agriculture	23,565	2.2%
9	Rock/barren	1,876	0.2%
10	Urban	192	0.0%
11	Water	2,941	0.3%

See Appendix I for maps of Fire Regime and Conditions Class.

3.10.3 Predicted Fire Severity

Current fire severity (CFS) is an estimate of the relative fire severity if a fire were to burn a site under its current state of vegetation. In other words, how much of the overstory would be removed if a fire were to burn today. The US Forest Service (Flathead National Forest) did not attempt to model absolute values of fire severity, as there are too many variables that influence fire effects at any given time (for example, temperature, humidity, fuel moisture, slope, wind speed, wind direction).

The characterization of likely fire severity was based upon historic fire regimes, potential natural vegetation, cover type, size class, and canopy cover with respect to slope and aspect. Each cover type was assigned a qualitative rating of fire tolerance based upon likely species composition and the relative resistance of each species to fire. The US Forest Service researchers defined 3 broad classes of fire tolerance: high tolerance (<20 percent post-fire mortality); moderate tolerance (20 to 80 percent mortality); and low tolerance (>80 percent mortality). We would expect that fires would be less severe within cover types comprised by species that have a high tolerance to fire (for example, western larch and ponderosa pine). Conversely, fires would likely burn more severely within cover types comprised by species having a low tolerance to fire (for example grand fir, subalpine fir). Data assignments were based upon our collective experience in the field, as well as stand structure characteristics reported in the fire-history literature. For example, if they estimated that a fire would remove less than 20 percent of the overstory, the current fire severity would be assigned to the non-lethal class (that is, NL). However, if they expected fire to remove more than 80 percent of the overstory, the current fire severity was assigned to a stand replacement class (that is, SR or SR3).

3.10.3.1 Purpose

Fire is a dominant disturbance process in the Northern Rockies. The likely effect of fire upon vegetation (i.e., current fire severity) is critical information for understanding the subsequent fire effects upon wildlife habitats, water quality, and the timing of runoff. There have been many reports of how fire suppression and timber harvest has affected vegetation patterns, fuels, and

fire behavior. The US Forest Service researchers from the Flathead National Forest, derived the current fire severity theme explicitly to compare with the historical fire regime theme to evaluate how fire severity has changed since Euro-American settlement (that is, to derive fire-regime condition class).

3.10.3.2 General Limitations

These data were designed to characterize broad scale patterns of estimated fire severity for use in regional and subregional assessments. Any decisions based on these data should be supported with field verification, especially at scales finer than 1:100,000. Although the resolution of the CFS theme is 90 meter cell size, the expected accuracy does not warrant their use for analyses of areas smaller than about 10,000 acres (for example, assessments that typically require 1:24,000 data).

Current fire severity rule-set was developed for an "average burn day" for the specific vegetation types in our area. Any user of these data should familiarize themselves with the rule sets to better understand our estimate of current fire severity. As with the Fire Regime Condition Class, this analysis was completed only for a portion of Petroleum County. The results are summarized in Table 3.19.

Table 3.19. Predicted Fire Severity by area in Petroleum County.

Predicted Fire Severity		Acres	Percent of Area
0	Not Evaluated	704,178	65.8%
1	non-lethal	2,403	0.2%
2	mixed severity, short interval	1,551	0.1%
3	mixed severity, long interval	1,369	0.1%
5	stand replacement, forest	1,531	0.1%
7	stand replacement, nonforest	330,461	30.9%
8	agriculture	23,544	2.2%
9	rock/barren	1,877	0.2%
10	urban	190	0.0%
11	water	2,924	0.3%
13	no information	82	0.0%

See Appendix I for a map of Predicted Fire Severity.

3.10.4 On-Site Evaluations

Fire control and evaluation specialists as well as hazard mitigation consultants evaluated the communities of Petroleum County to determine, first-hand, the extent of risk and characteristics of hazardous fuels in the Wildland-Urban Interface. The on-site evaluations have been summarized in written narratives and are accompanied by photographs taken during the site visits. These evaluations included the estimation of fuel models as established by Anderson (1982). These fuel models are described in the following section of this document.

In addition, field personnel completed FEMA's Fire Hazard Severity Forms and Fire Hazard Rating Criteria Worksheets. These worksheets and standardized rating criteria allow comparisons to be made between all of the counties in the country using the same benchmarks. The FEMA rating forms are summarized for each community in Appendix II.

3.10.5 Fuel Model Descriptions

Anderson (1982) developed a categorical guide for determining fuel models to facilitate the linkage between fuels and fire behavior. These 13 fuel models, grouped into 4 basic groups: grass, chaparral and shrub, timber, and slash, provide the basis for communicating fuel conditions and evaluating fire risk. There are a number of ways to estimate fuel models in forest and rangeland conditions. The field personnel from Northwest Management, Inc., that evaluated communities and other areas of Petroleum County have all been intricately involved in wildland fire fighting and the incident command system. They made ocular estimates of fuel models they observed. In an intense evaluation, actual sampling would have been employed to determine fuel models and fuel loading. The estimations presented in this document (Chapter 3) are estimates based on observations to better understand the conditions observed.

Fuel Model 0- This type consists of non-flammable sites, such as exposed mineral soil and rock outcrops. Other lands are also identified in this type.

3.10.5.1 Grass Group

3.10.5.1.1 Fire Behavior Fuel Model 1

Fire spread is governed by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material. Very little shrub or timber is present, generally less than one-third of the area.

Grasslands and savanna are represented along with stubble, grass-tundra, and grass-shrub combinations that met the above area constraint. Annual and perennial grasses are included in this fuel model.

This fuel model correlates to 1978 NFDRS fuel models A, L, and S.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and alive, tons/acre 0.74
Dead fuel load, ¼-inch, tons/acre 0.74
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 1.0

3.10.5.1.2 Fire Behavior Fuel Model 2

Fire is spread primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, in addition to litter and dead-down stemwood from the open shrub or timber overstory, contribute to the fire intensity. Open shrub lands and pine stands or scrub oak stands that cover one-third to two-thirds of the area may generally fit this model; such stands may include clumps of fuels that generate higher intensities that may produce firebrands. Some pinyon-juniper may be in this model.

This fuel model correlates to 1978 NFDRS fuel models C and T.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and alive, tons/acre 4.0
Dead fuel load, ¼-inch, tons/acre 2.0
Live fuel load, foliage, tons/acre 0.5
Fuel bed depth, feet 1.0

3.10.5.1.3 Fire Behavior Fuel Model 3

Fires in this fuel are the most intense of the grass group and display high rates of spread under the influence of wind. Wind may drive fire into the upper heights of the grass and across standing water. Stands are tall, averaging about 3 feet (1 m), but considerable variation may occur. Approximately one-third or more of the stand is considered dead or cured and maintains the fire. Wild or cultivated grains that have not been harvested can be considered similar to tall prairie and marshland grasses.

This fuel correlates to 1978 NFDRS fuel model N.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre 3.0
Dead fuel load, ¼-inch, tons/acre 3.0
Live fuel load, foliage tons/acre 0
Fuel bed depth, feet 2.5

3.10.5.2 Shrub Group

3.10.5.2.1 Fire Behavior Fuel Model 4

Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. Stands of mature shrubs, 6 or more feet tall, such as California mixed chaparral, the high pocosin along the east coast, the pinebarrens of New Jersey, or the closed jack pine stands of the north-central States are typical candidates. Besides flammable foliage, dead woody material in the stands significantly contributes to the fire intensity. Height of stand qualifying for this model depends on local conditions. A deep litter layer may also hamper suppression efforts.

This fuel model represents 1978 NFDRS fuel models B and O; fire behavior estimates are more severe than obtained by Models B or O.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch dead and live, tons/acre 13.0
Dead fuel load, ¼-inch, tons/acre 5.0
Live fuel load, foliage, tons/acre 5.0
Fuel bed depth, feet 6.0

3.10.5.2.2 Fire Behavior Fuel Model 5

Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and the grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead material, and the foliage contains little volatile material. Usually shrubs are short and almost totally cover the area. Young, green stands with no dead wood would qualify: laurel, vine maple, alder, or even chaparral, manzanita, or chamise.

No 1978 NFDRS fuel model is represented, but model 5 can be considered as second choice for NFDRS model D or as third choice for NFDRS model T. Young green stands may be up to 6 feet (2m) high but have poor burning properties because of live vegetation.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch dead and live, tons/acre 3.5
Dead fuel load, ¼-inch, tons/acre 1.0
Live fuel load, foliage, tons/acre 2.0
Fuel bed depth, feet 2.0

3.10.5.2.3 Fire Behavior Fuel Model 6

Fires carry through the shrub layer where the foliage is more flammable than fuel model 5, but this requires moderate winds, greater than 8 mi/h (13 km/h) at mid-flame height. Fire will drop to the ground at low wind speeds or at openings in the stand. The shrubs are older, but not as tall as shrub types of model 4, nor do they contain as much fuel as model 4. A broad range of shrub conditions is covered by this model. Fuel situations to be considered include intermediate stands of chamise, chaparral, oak brush, low pocosin, Alaskan spruce taiga, and shrub tundra. Even hardwood slash that has cured can be considered. Pinyon-juniper shrublands may be represented but may over-predict rate of spread except at high winds, like 20 mi/h (32 km/h) at the 20-foot level.

The 1978 NFDRS fuel models F and Q are represented by this fuel model. It can be considered a second choice for models T and D and a third choice for model S.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch dead and live, tons/acres..... 6.0
Dead fuel load, 1/4 –inch, tons/acre 1.5
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 2.5

3.10.5.2.4 Fire Behavior Fuel Model 7

Fires burn through the surface and shrub strata with equal ease and can occur at higher dead fuel moisture contents because of the flammability of live foliage and other live material. Stands of shrubs are generally between 2 and 6 feet (0.6 and 1.8 m) high. Palmetto-gallberry understory-pine overstory sites are typical and low pocosins may be represented. Black spruce-shrub combinations in Alaska may also be represented.

This fuel model correlates with 1978 NFDRS model D and can be a second choice for model Q.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch dead and live, tons/acre 4.9
Dead fuel load, ¼-inch, tons/acre 1.1
Live fuel load, foliage, tons/acre 0.4
Fuel bed depth, feet 2.5

3.10.5.3 Timber Group

3.10.5.3.1 Fire Behavior Fuel Model 8

Slow-burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional “jackpot” or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humilities, and high winds do the fuels pose fire hazards. Closed canopy stands of short-needle conifers or hardwoods that have

leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand. Representative conifer types are white pine, and lodgepole pine, spruce, fir and larch

This model can be used for 1978 NFDRS fuel models H and R.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch, dead and live, tons/acre 5.0
Dead fuel load, ¼-inch, tons/acre 1.5
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 0.2

3.10.5.3.2 Fire Behavior Fuel Model 9

Fires run through the surface litter faster than model 8 and have longer flame height. Both long-needle conifer stands and hardwood stands, especially the oak-hickory types, are typical. Fall fires in hardwoods are predictable, but high winds will actually cause higher rates of spread than predicted because of spotting caused by rolling and blowing leaves. Closed stands of long-needled pine like ponderosa, Jeffrey, and red pines, or southern pine plantations are grouped in this model. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning.

NFDRS fuel models E, P, and U are represented by this model. It is also a second choice for models C and S.

Fuel model values for estimating fire behavior

Total fuel load, <3-inch dead and live, tons/acre 3.5
Dead fuel load, ¼-inch, tons/acre 2.9
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 0.2

3.10.5.3.3 Fire Behavior Fuel Model 10

The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch (7.6 cm) or larger limbwood, resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, wind-thrown stands, overmature situations with dead fall, and aged light thinning or partial-cut slash.

The 1978 NFDRS fuel model G is represented.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre 12.0
Dead fuel load, ¼-inch, tons/acre 3.0
Live fuel load, foliage, tons/acre 2.0
Fuel bed depth, feet 1.0

The fire intensities and spread rates of these timber litter fuel models are indicated by the following values when the dead fuel moisture content is 8 percent, live fuel moisture is 100 percent, and the effective windspeed at mid-flame height is 5 mi/h (8 km/h):

Table 3.20. Comparative Fire Intensities and Rates of Spread in Timber Fuel Models.

Fuel Model	Rate of Spread Chains/hour	Flame length Feet
8	1.6	1.0
9	7.5	2.6
10	7.9	4.8

Fires such as above in model 10 are at the upper limit of control by direct attack. More wind or drier conditions could lead to an escaped fire.

3.10.5.4 Logging Slash Group

3.10.5.4.1 Fire Behavior Fuel Model 11

Fires are fairly active in the slash and herbaceous material intermixed with the slash. The spacing of the rather light fuel load, shading from overstory, or the aging of the fine fuels can contribute to limiting the fire potential. Light partial cuts or thinning operations in mixed conifer stands, hardwood stands, and southern pine harvests are considered. Clearcut operations generally produce more slash than represented here. The less-than-3-inch (7.6-cm) material load is less than 12 tons per acre (5.4 t/ha). The greater-than-3-inch (7.6-cm) is represented by not more than 10 pieces, 4 inches (10.2 cm) in diameter, along a 50-foot (15 m) transect.

The 1978 NFDRS fuel model K is represented by this model.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch, dead and live, tons/acre 11.5
Dead fuel load, ¼-inch, tons/acre 1.5
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 1.0

3.10.5.4.2 Fire Behavior Fuel Model 12

Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts, it is generally sustained until a fuel break or change in fuels is encountered. The visual impression is dominated by slash and much of it is less than 3 inches (7.6 cm) in diameter. The fuels total less than 35 tons per acres (15.6 t/ha) and seem well distributed. Heavily thinned conifer stands, clearcuts, and medium or heavy partial cuts are represented. The material larger than 3 inches (7.6 cm) is represented by encountering 11 pieces, 6 inches (15.3 cm) in diameter, along a 50-foot (15-m) transect.

This model depicts 1978 NFDRS model J and may overrate slash areas when the needles have dropped and the limbwood has settled. However, in areas where limbwood breakup and general weathering have started, the fire potential can increase.

Fuel model values fore estimating fire behavior

Total fuel load, < 3-inch, dead and live, tons/acre 34.6
Dead fuel load, ¼-inch, tons/acre 4.0
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 2.3

3.10.5.4.3 Fire Behavior Fuel Model 13

Fire is generally carried across the area by a continuous layer of slash. Large quantities of material larger than 3 inches (7.6 cm) are present. Fires spread quickly through the fine fuels and intensity builds up more slowly as the large fuels start burning. Active flaming is sustained for long periods and a wide variety of firebrands can be generated. These contribute to spotting problems as the weather conditions become more severe. Clearcuts and heavy partial-cuts in mature and overmature stands are depicted where the slash load is dominated by the greater-than-3-inch (7.6-cm) diameter material. The total load may exceed 200 tons per acre (89.2 t/ha) but fuel less than 3 inches (7.6 cm) is generally only 10 percent of the total load. Situations where the slash still has "red' needles attached but the total load is lighter, more like model 12, can be represented because of the earlier high intensity and quicker area involvement.

The 1978 NFDRS fuel model I is represented. Areas most commonly fitting his model are old-growth stands west of the Cascade and Sierra Nevada Mountains. More efficient utilization standards are decreasing the amount of large material left in the field.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre 58.1
Dead fuel load, ¼-inch, tons/acre 7.0
Live fuel load, foliage, tons/acre 0
Fuel bed depth, feet 3.0

For other slash situations:

Hardwood slash .....Model 6
Heavy "red" slash.....Model 4
Overgrown slash .....Model 10
Southern pine clearcut slash.....Model 12

The comparative rates of spread and flame lengths for the slash models at 8 percent dead fuel moisture content and a 5 mi/h (8 km/h) mid-flame wind are presented in Table 3.21.

Table 3.21. Comparative Fire Intensities and Rates of Spread in Slash Fuel Models.

Fuel Model	Rate of Spread Chains/hour	Flame length Feet
11	6.0	3.5
12	13.0	8.0
13	13.5	10.5

3.11 Wildland-Urban Interface

3.11.1 People and Structures

A key component in meeting the underlying need is the protection and treatment of fire hazard in the wildland-urban interface. The wildland-urban interface refers to areas where wildland vegetation meets urban developments, or where forest fuels meet urban fuels (such as houses). These areas encompass not only the interface (areas immediately adjacent to urban development), but also the continuous slopes and fuels that lead directly to a risk to urban developments. Reducing the fire hazard in the wildland urban interface requires the efforts of

federal, state, local agencies, and private individuals (Norton 2002). “The role of [most] federal agencies in the wildland urban interface includes wildland fire fighting, hazard fuels reduction, cooperative prevention and education and technical experience. Structural fire protection [during a wildfire] in the wildland urban interface is [largely] the responsibility of Tribal, state, and local governments” (USFS 2001). Property owners share a responsibility to protect their residences and businesses and minimize fire danger by creating defensible areas around them and taking other measures to minimize the fire risks to their structures (USFS 2001). With treatment, a wildland-urban interface can provide firefighters a defensible area from which to suppress wildland fires or defend communities. In addition, a wildland urban interface that is properly thinned will be less likely to sustain a crown fire that enters or originates within it (Norton 2002).

By reducing hazardous fuel loads, ladder fuels, and tree densities, and creating new and reinforcing defensible space, landowners would protect the wildland-urban interface, the biological resources of the management area, and adjacent property owners by:

- minimizing the potential of high-severity ground or crown fires entering or leaving the area;
- reducing the potential for firebrands (embers carried by the wind in front of the wildfire) impacting the WUI. Research indicates that flying sparks and embers (firebrands) from a crown fire can ignite additional wildfires as far as 1¼ miles away during periods of extreme fire weather and fire behavior (McCoy *et al.* 2001 as cited in Norton 2002);
- improving defensible space in the immediate areas for suppression efforts in the event of wildland fire.

Four wildland/urban conditions have been identified for use in the wildland urban interface (Norton 2002). These include the Interface Condition, Intermix Condition, Occluded Condition, and Rural Condition. Descriptions of each are as follows:

- **Interface Condition** – a situation where structures abut wildland fuels. There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences. The development density for an interface condition is usually 3+ structures per acre;
- **Intermix Condition** – a situation where structures are scattered throughout a wildland area. There is no clear line of demarcation, the wildland fuels are continuous outside of and within the developed area. The development density in the intermix ranges from structures very close together to one structure per 40 acres;
- **Occluded Condition** – a situation, normally within a city, where structures abut an island of wildland fuels (park or open space). There is a clear line of demarcation between the structures and the wildland fuels along roads and fences. The development density for an occluded condition is usually similar to that found in the interface condition and the occluded area is usually less than 1,000 acres in size; and
- **Rural Condition** – a situation where the scattered small clusters of structures (ranches, farms, resorts, or summer cabins) are exposed to wildland fuels. There may be miles between these clusters.

The location of structures in Petroleum County have been mapped and are presented on a variety of maps in this analysis document; specifically in Appendix I. The location of all structures was mapped by using a database created by the Fergus County Planning Department showing the location of all addresses in the three counties of Fergus, Petroleum, and Judith Basin County. These were determined using remotely sensed images and GPS

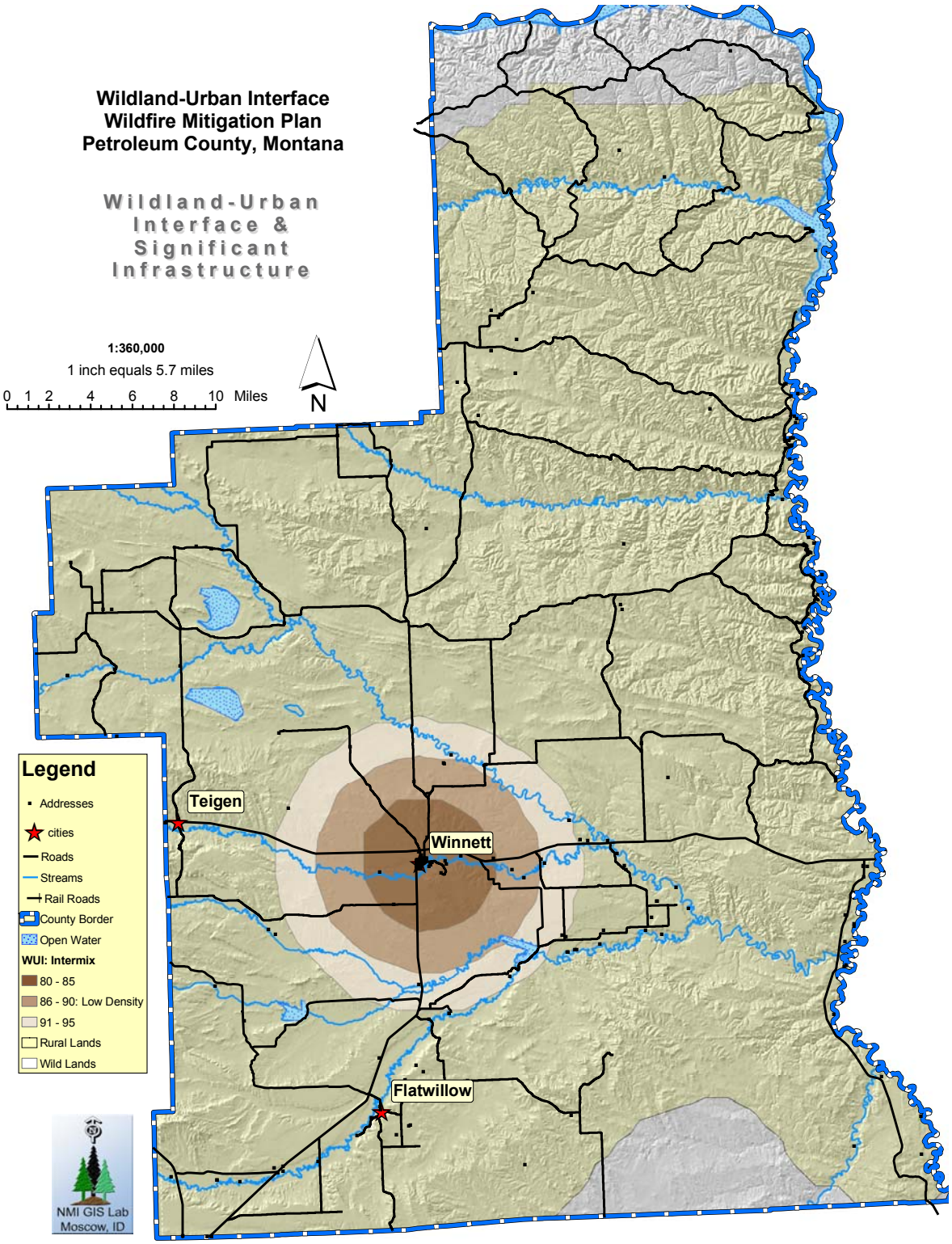
units. These records were augmented with data collected on hand-held GPS receivers to record the location of structures, especially in areas where new housing developments were seen.

All addresses are represented by a “dot” on the map. The density of structures and their specific locations in this County are critical in defining where the potential exists for casualty loss in the event of a wildfire in the region.

By evaluating this structure density, we can define WUI areas on maps by using mathematical formulae and population density indexes to define the WUI based on where structures are located. The resulting population density indexes create concentric circles showing high density areas of Interface and Intermix WUI, as well as Rural WUI (as defined by Secretary Norton of the Department of Interior). This portion of the analysis allows us to “see” where the highest concentrations of structures are located in reference to high risk landscapes, limiting infrastructure, and other points of concern.

It is critical to understand that in the protection of people, structures, infrastructure, and unique ecosystems, this portion of the analysis only serves to identify structures and by some extension the people that inhabit them. It does not define the location of infrastructure and unique ecosystems. Other analysis tools will be used for those items.

The WUI interface areas as defined here are presented in map form in Appendix I.



This map is presented for reference in this section of the plan. This map, and additional maps are detailed in Appendix I.

3.11.2 Infrastructure

Petroleum County has both significant infrastructure and unique ecosystems within its boundaries. Of note for this WUI Fire Mitigation Plan is the existence of highway routes (eg., State Highways 200 and 244), oil fields, and the presence of electrical transmission lines. These resources will be considered in the protection of infrastructural resources for Petroleum County and to the larger extent of this region, and the rest of Montana.

High Tension Power Lines have been mapped and are presented in Appendix I. Protection of these lines from loss during a wildfire is paramount in as much as the electrical power they provide serves not only the communities of Petroleum County but of surrounding counties. The protection of these lines allows for community sustainability, support of the economic viability of Petroleum County, and the protection of people who rely on that power. Fuels mitigation under power lines has received considerable attention in forested ecosystems as timber is thinned and heavy accumulations of brush are managed. However, the importance of management of rangeland ecosystems under high tension power lines should not be overlooked. Brush intermixed with grasses and other species, during extreme fire weather events, coupled with steep slopes can produce considerable heat and particulate matter. When this occurs under power lines, the result can be arcing between lines and even failure of the electrical media itself. Fuel mitigation treatments in high risk areas, especially where multiple lines are co-located, will be recommended for treatments.

3.11.3 Ecosystems

Petroleum County is a diverse ecosystem with a complex array of vegetation, wildlife, and fisheries that have developed with, and adapted to fire as a natural disturbance process. A century of wildland fire suppression coupled with past land-use practices (primarily livestock grazing) has altered plant community succession and has resulted in dramatic shifts in the fire regimes and species composition. As a result, forests and rangelands in Petroleum County have become more susceptible to large-scale, high intensity fires posing a threat to life, property, and natural resources including wildlife and special status plant populations and habitats. High-intensity, stand-replacing fires have the potential to seriously damage soils and native vegetation. In addition, an increase in the number of large high intensity fires throughout the nation's forest and rangelands, has resulted in significant safety risks to firefighters and higher costs for fire suppression (House of Representatives, Committee on Agriculture, Washington, DC, 1997).

3.12 Soils

Our soil resource is an extremely important component for maintaining a healthy ecosystem and economy. Fire can play an intricate role in this process, if it occurs under normal conditions of light fuels associated with low intensity underburns. However, the buildup of fuels and consequent high severity fires can cause soils to become water repellent (hydrophobic), and thus greatly increases the potential for overland flow during intense rains. Soil in degraded conditions does not function normally, and will not be able to sustain water quality, water yield, or plant communities that have normal structure, composition, and function. Fire is also strongly correlated with the carbon-nutrient cycles and the hydrologic cycle. Fire frequency, extent, and severity are controlled to a large degree by the availability of carbon, as well as the moisture regime (Quigley & Arbelbide 1997).

Soils were evaluated for their propensity to become hydrophobic during and after a fire as evidenced by the presence of clay and clay derivatives (e.g., clay loam, cobbly clay) in the upper soil layers. In addition, their permeability and tendency to allow runoff to infiltrate the soil

rapidly was evaluated. In general, with notable exceptions, the majority of the area within Petroleum County has high clay content in the surface horizons. The A and C horizons are predominately clay loam with underlying shale. On average these soils are well drained with moderate permeability. Forested areas have somewhat more developed soils. These areas are characterized by a thin O horizon made up of decomposing forest litter underlain by cobbly silty clay loam.

Low to moderate intensity fires would not be expected to damage soil characteristics in the region, especially if the hotter fires in this range were limited to small extents associated with jackpots of cured fuels. Hot fires providing intense heat to the C horizon substrate depth have the potential to create hydrophobic characteristics in that layer. This can result in increased overland flow during heavy rains, following wildfire events, potentially leading to mass wasting. Rocky and gravelly characteristics in the A horizon layer would be expected to be displaced, while the silty and loamy fines in these soils may experience an erosion and displacement potential. These soils will experience the greatest potential impacts resulting from hot fires that burn for prolonged periods (especially on steep slopes).

3.12.1 Fire Mitigation Practices to Maintain Soil Processes

Firelines constructed by hand or with the use of machinery will have varying impacts, depending upon construction techniques. If only the surface litter is removed in the fireline construction, minor increases to soil erosion may occur. If trenches are dug which channelize runoff down steep slopes, heavy rilling or gullying could occur depending upon rock content of surface layers exposed. Jackpot burning and, to a greater extent, pile burning would result in greater soil heating and localized impacts. Loss of soil carbon, nitrogen, sulphur, phosphorus, potassium, and soil organisms would be high in the soil surface layer. Soil physical structure could be altered thereby creating hydrophobic soils, especially where clay content is moderate or high.

Indirect effects of prescribed burning and wildfires to slope stability are highly variable in the soil types found in Petroleum County. Vegetation structure, including root strength after burning, is maintained from three to fifteen years following low to moderate intensity burns and therefore soil saturation potential is not greatly altered. Re-vegetation of burned areas within this time frame will be a critical component to maintaining soil resources and pre-empting noxious weeds and invasive species from occupying the site. Locale experiencing high intensity burns will need to be evaluated immediately for mechanical erosion control followed by re-vegetation efforts. Holding soils in place will be a difficult challenge in many locations, especially on moderate to steep slopes.

Where heavy grazing has occurred in the past, there is also a possibility that soil productivity has been reduced. This is especially true in riparian areas where animal concentrations have historically been the greatest. These areas generally have easily compacted soils, and are where cattle tend to linger if not managed well. Mining also has significant effects on soil quality through soil compaction and mass displacement. Grazing across Petroleum County was observed to be maintained in a sustainable manner without the overgrazing found in other areas of the region.

Severe fires in the past have consumed surface organics and volatilized nitrogen into the air. On some sites, however, these severe burns are a natural process, and therefore the inherent soil productivity may not be reduced. On other sites, however, where low intensity underburns typically occurred, high intensity wildland fires have consumed amounts of soil organics in excess of the historic patterns. Furthermore, excessive soil heating in these intense fires likely resulted in creation of water repellent soils, and therefore increased overland flow and soil erosion. In these cases, it can be assumed that wildland fires have reduced long-term soil

productivity. Soil compaction damage typically is persistent in the area; several decades of rest from further compactive forces are needed until adequate soil recovery occurs. Loss of organics due to displacement and severe fire also requires decades to recuperate. This slow recovery from soil damage makes cumulative effects to soil productivity and soil hydrologic function a major concern.

To avoid potential impacts, wherever possible firelines should be located outside of highly erosive areas, steep slopes, intermittent streams, and riparian and other sensitive areas. Following prescribed fire or fire suppression activities, firelines should be rehabilitated.

3.13 Hydrology

The Montana Department of Natural Resources and Conservation Water Resources Division is charged with the development of the Montana State Ground Water Plan. Included in the Plan is the statewide water policy plan along with detailed subsections regarding the protection, education, and remediation of Montana's ground water resources. The Montana DNRC Water Resources Division has prepared Surface Water Supply Index Maps for all of the surface water systems in Montana. This agency also addresses statewide floodplain management, streamflow conditions, and dams and canals, and water rights issues.

The geology and soils of this region lead to slow to moderate moisture infiltration. Soils that have a clay pan or clay layer near the surface inhibit downward water transmission; thus, have a high potential for overland flow. Clay soils also have a high shrink swell potential. Disrupted vegetation patterns from logging or agriculture (soil compaction) and wildland fire (especially hot fires that increase soil hydrophobic characteristics), can lead to increased surface runoff and debris flow to stream channels.

A correlation to mass wasting due to the removal of vegetation caused by high intensity wildland fire has been documented for the central Montana region. Burned vegetation can result in changes in soil moisture and loss of rooting strength that can result in slope instability, especially on slopes greater than 30%. The greatest watershed impacts from increased sediment will be in the lower gradient, depositional stream reaches.

3.13.1 Fire Mitigation Practices to Maintain Hydrologic Processes

The effects of wildland fire and prescribed burning on water quality are variable. The removal of the vegetative canopy will tend to reduce transpiration and increase water yield, especially during the growing season and immediately afterwards (MacDonald *et al.* 1991). Prescribed burning is used to maintain a healthy, dynamic ecosystem while meeting land management objectives. Prescribed burning objectives include reduction of natural fuels, assuring current and future habitat conditions for native plants and animals, improvement of forest health, and enhancement, protection, and maintenance of old growth and riparian areas. The majority of the burned areas are expected to receive a low intensity ground fires with some areas of moderate intensity. This may include occasional torching of single trees or larger clumps or trees and consumption of some patches of regeneration. Impacts to soil and large woody debris are expected to be minimal, given project targets. In rangeland ecosystems, prescribed fire will have variable impacts dependant on burn intensity and proximity to streams. Stream buffering (low intensity to no burn around streams) has been shown to preserve most if not all normal sediment filtering functions.

A large, stand-replacing fire could have negative effects on watershed conditions, thus affecting both fish and habitat in streams. Treatment with low to moderate intensity fire would result in a mosaic pattern of burned and unburned areas of ground level vegetation species and ground level natural fuels. Some patches of shade-tolerant, fire intolerant species may also be

consumed. Prescribed burning is not designed to consume all vegetation within project areas. Each treatment will leave a mosaic of burned and unburned areas. Once the target fuels and the risk of fire carrying from one tributary to another have been reduced, hand ignition may be considered on a site-specific basis.

The effects on sediment yield vary according to the intensity of fire; degree of soil disturbance; steepness of the slope and drainage network; the size of the area burned; and the extent to which the vegetation controls the movement and storage of sediment. Fire also increases surface erosion and sediment delivery rates by removing the litter layer and organic debris that traps sediment both on slopes and in the stream channel (MacDonald *et al.* 1991). The magnitude of these effects will depend on the geomorphic sensitivity of the landscape, which is largely a function of slope steepness and parent material (Swanson 1978).

Fire can greatly increase surface erosion by temporarily creating a hydrophobic soil layer. Soils within the project area are generally at moderate risk for hydrophobic conditions due to their fine-grained textures and clay content. In addition, the relatively low burn intensity of the prescribed fires will also help prevent the formation of hydrophobic soils.

The effects of wildland fire or prescribed fire are generally considered in terms of potential short-term, negative effects and long-term benefits of fuels reduction, which will result in a decreased risk of high intensity, stand-replacing fire. Potential short-term effects to streams and fish include increased risk of landslides, mass movement and debris torrents, increases in surface sediment erosion, possible reduction in streamside vegetation resulting in changes within management areas, and possible increases in water yield depending on the amount and severity of the vegetation burned. Long-term effects include increases in nutrient delivery, possible increases in woody debris in streams, and possible increases in stream temperature if shading is significantly reduced. The design criteria described above minimizes the risk that landslides, mass movement, significant increases in surface sediment yield, and significant changes in water yield will occur.

Reduction of vegetation will mostly be limited to creeping ground fires, which will reduce understory vegetation, but will not affect mature trees or result in significant mortality to the overstory. Spring burning often results in minimal riparian vegetation burned because streamside areas have higher humidity and live plant moisture. Fall burning will more likely result in understory vegetation removal, with a possibility of some tree and large shrub mortality, especially outside of riparian zones where live plant moisture is less.

Riparian buffer strips will be maintained, thereby preserving canopy cover for shading, sediment filtering, and streambank and floodplain stability. Areas not burned will provide significant protection from adverse water quality impacts associated with wildland fire and prescribed burning. Therefore, effects to fish and habitat in these streams from increased water yield are unlikely. The area has been roaded from past management activities. Therefore, increased road densities from road construction are not expected to be of a magnitude to increase sedimentation to affected drainages, provided adequate planning for new road construction is implemented. Forest practices in the area will be conducted to meet the standards of the Montana Streamside Management Zone Law. These rules are designed to use best management practices that are adapted to and take account of the specific factors influencing water quality, water quality objectives, on-site conditions, and other factors applicable to the site where a forest practice occurs.

3.14 Air Quality

The primary means by which the protection and enhancement of air quality is accomplished is through implementation of National Ambient Air Quality Standards (NAAQS). These standards

address six pollutants known to harm human health including ozone, carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxides (USDA Forest Service 2000).

Smoke emissions from fires potentially affect an area and the airsheds that surround it. Climatic conditions affecting air quality in Central Montana are governed by a combination of factors. Large-scale influences include latitude, altitude, prevailing hemispheric wind patterns, and mountain barriers. At a smaller scale, topography and vegetation cover also affect air movement patterns. Air quality in the area and surrounding airshed is generally good to excellent. However, locally adverse conditions can result from occasional wildland fires in the summer and fall, and prescribed fire and agricultural burning in the spring and fall. All major river drainages are subject to temperature inversions which trap smoke and affect dispersion, causing local air quality problems.

Smoke management in Petroleum County is managed by the Idaho/Montana Airshed Group. The entire county falls into Airshed Unit 9 (Levinson 2002). An airshed is a geographical area which is characterized by similar topography and weather patterns (or in which atmospheric characteristics are similar, e.g., mixing height and transport winds). There are currently no impact zones near Petroleum County. The USDA Forest Service, Bureau of Land Management, US Fish and Wildlife Service, and the Montana Department of Natural Resources and Conservation are all members of the Montana/Idaho State Airshed Group, which is responsible for coordinating burning activities to minimize or prevent impacts from smoke emissions. Prescribed burning must be coordinated through the Missoula Monitoring Unit, which coordinates burn information, provides smoke forecasting, and establishes air quality restrictions for the Montana/Idaho Airshed Group. The Monitoring Unit issues daily decisions which may restrict burning when atmospheric conditions are not conducive to good smoke dispersion. Burning restrictions are issued for airsheds, impact zones, and specific projects. The monitoring unit is active March through November. Each Airshed Group member is also responsible for smoke management all year.

The Clean Air Act, passed in 1963 and amended in 1977, is the primary legal authority governing air resource management. The act established a process for designation of Class I and Class II areas for air quality management. Class I areas receive the highest level of protection and numerical thresholds for pollutants. The U. L. Bend National Wildlife Refuge in Phillips County is the only Class 1 area in close proximity to Petroleum County.

Residents and resources in Petroleum County could be affected by smoke or regional haze from burning activities in the region. Montana Department of Environmental Quality maintains Air Pollution Monitoring Sites throughout Montana. The Air Pollution Monitoring program monitors all of the six criteria pollutants. Measurements are taken to assess areas where there may be a problem, and to monitor areas that already have problems. The goal of this program is to control areas where problems exist and to try to keep other areas from becoming problem air pollution areas (Louks 2001).

The Clean Air Act provides the principal framework for national, state, and local efforts to protect air quality. Under the Clean Air Act, OAQPS (Organization for Air Quality Protection Standards) is responsible for setting standards, also known as national ambient air quality standards (NAAQS), for pollutants which are considered harmful to people and the environment. OAQPS is also responsible for ensuring these air quality standards are met, or attained (in cooperation with state, Tribal, and local governments) through national standards and strategies to control pollutant emissions from automobiles, factories, and other sources (Louks 2001).

3.14.1 Fire Mitigation Practices to Maintain Air Quality

Smoke consists of dispersed airborne solids and liquid particles, called particulates, which can remain suspended in the atmosphere for a few days to several months. Particulates can reduce visibility and contribute to respiratory problems. Very small particulates can travel great distances and add to regional haze problems. Regional haze can sometimes result from multiple burn days and/or multiple owners burning within an airshed over too short a period of time to allow for dispersion.

For prescribed fires, there are three principle strategies to manage smoke and reduce air quality effects. They include:

1. **Avoidance -** This strategy relies on monitoring meteorological conditions when scheduling prescribed fires to prevent smoke from drifting into sensitive receptors, or suspending burning until favorable weather (wind) conditions exist. Sensitive receptors can be human-related (e.g. campgrounds, schools, churches, and retirement homes) or wildlife-related (threatened and endangered species and their critical habitats);
2. **Dilution –** This strategy ensures proper smoke dispersion in smoke sensitive areas by controlling the rate of smoke emissions or scheduling prescribed fires when weather systems are unstable, not under conditions when a stable high-pressure area is forming with an associated subsidence inversion. An inversion would trap smoke near the ground; and
3. **Emission Reduction –** This strategy utilizes techniques to minimize the smoke output per unit area treated. Smoke emission is affected by the number of acres burned at one time, pre-burn fuel loadings, fuel consumption, and the emission factor. Reducing the number of acres burned at one time would reduce the amount of emissions generated by that burn. Reducing the fuel beforehand reduces the amount of fuel available. Prescribed burning when fuel moistures are high can reduce fuel consumption. Emission factors can be reduced by pile burning or by using certain firing techniques such as mass ignition.

If weather conditions changed unexpectedly during a prescribed burn, and there was a potential for violating air quality standards or for adverse smoke impacts on sensitive receptors (schools, churches, hospitals, retirement homes, campgrounds, wilderness areas, and species of threatened or endangered wildlife), the management organization may implement a contingency plan, including the option for immediate suppression. Considering 1) the proposed action would result in prescribed fire on a relatively small number of acres, 2) burning as part of this mitigation plan's implementation in the County will most likely occur over a 5-year or 10-year period at a minimum, and 3) the County will adhere to Montana/Idaho Airshed Group advisories and management strategies to minimize smoke emissions, prescribed fire activities would not violate national or state emission standards and would cause very minor and temporary air quality impacts. The greatest threat to air quality would be smoke impacts on sensitive receptors; however, the relative scarcity of sensitive receptors within the County minimizes this potential air quality impact.

In studies conducted through the Interior Columbia Basin Management Project, smoke emissions were simulated across the Basin to assess relative differences among historical, current, and future management scenarios. In assessing the whole Upper Columbia Basin, there was a 43 percent reduction in smoke emissions between the historical and current periods (Quigley and Arbelbide 1997). The projected smoke emissions varied substantially with the vastly different management scenarios. The consumptive demand and passive management

scenarios were projected to substantially increase smoke emissions above current levels. The active management scenarios were projected to result in a decrease of current levels.

Although prescribed fire smoke would occur more frequently than wildland fire smoke, since prescribed fires are scheduled during the year, the effects of wildland fire smoke on visibility are more acute. Prescribed fires produce less smoke than wildland fires for comparatively shorter periods, because they are conducted under weather conditions that provide for better smoke dispersion. In a study conducted by Holsapple and Snell (1996), wildland fire and prescribed fire scenarios for the Columbia Basin were modeled. In conclusion, the prescribed fire scenarios did not exceed the EPA particulate matter (PM 10) standard in a 24-hour period. Similar projections were observed for a PM 2.5 threshold. Conversely, all wildland fire scenarios exceeded air quality standards. Similar responses were reported by Huff *et al.* (1995) and Ottmar *et al.* (1996) when they compared the effects of wildland fire to prescribed fire on air quality. The impacts of wildland fire and management ignited prescribed fire on air quality vary because of the differences in distribution of acres burned, the amount of fuel consumed per acre (due to fuel moisture differences), and the weather conditions in which typical spring and fall prescribed burns occur. This analysis reveals wildland fire impacts on air quality may be significantly greater in magnitude than emissions from prescribed burns. This may be attributable, in part, to the fact that several states within the project area have smoke management plans requiring favorable weather conditions for smoke dispersion prior to igniting wildland fires (Quigley and Arbelbide 1997).

Chapter 4: Summaries of Risk and Preparedness

4 Overview

4.1 Wildland Fire Characteristics

An informed discussion of fire mitigation is not complete until basic concepts that govern fire behavior are understood. In the broadest sense, wildland fire behavior describes how fires burn; the manner in which fuels ignite, how flames develop and how fire spreads across the landscape. The three major physical components that determine fire behavior are the fuels supporting the fire, the topography in which the fire is burning, and the weather and atmospheric conditions during a fire event. At the landscape level, both topography and weather are beyond our control. We are powerless to control winds, temperature, relative humidity, atmospheric instability, slope, aspect, elevation, and landforms. It is beyond our control to alter these conditions, and thus impossible to alter fire behavior through their manipulation. When we attempt to alter how fires burn, we are left with manipulating the third component of the fire environment, the fuels which support the fire. By altering fuel loading and fuel continuity across the landscape, we have the best opportunity to determine how fires burn.

A brief description of each of the fire environment elements follows in order to illustrate their effect on fire behavior.

4.1.1 Weather

Weather conditions are ultimately responsible for determining fire behavior. Moisture, temperature, and relative humidity determine the rates at which fuels dry and vegetation cures, and whether fuel conditions become dry enough to sustain an ignition. Once conditions are capable of sustaining a fire, atmospheric stability and wind speed and direction can have a significant affect on fire behavior. Winds fan fires with oxygen, increasing the rate at which fire spreads across the landscape. Weather is the most unpredictable component governing fire behavior, constantly changing in time and across the landscape.

4.1.2 Topography

Fires burning in similar fuel conditions burn dramatically different under different topographic conditions. Topography alters heat transfer and localized weather conditions, which in turn influence vegetative growth and resulting fuels. Changes in slope and aspect can have significant influences on how fires burn. Generally speaking, north slopes tend to be cooler, wetter, more productive sites. This can lead to heavy fuel accumulations, with high fuel moistures, later curing of fuels, and lower rates of spread. The combination of light fuels and dry sites lead to fires that typically display the highest rates of spread. In contrast, south and west slopes tend to receive more direct sun, and thus have the highest temperatures, lowest soil and fuel moistures, and lightest fuels. These slopes also tend to be on the windward side of mountains. Thus these slopes tend to be “available to burn” a greater portion of the year.

Slope also plays a significant role in fire spread, by allowing preheating of fuels upslope of the burning fire. As slope increases, rate of spread and flame lengths tend to increase. Therefore, we can expect the fastest rates of spread on steep, warm south and west slopes with fuels that are exposed to the wind.

4.1.3 Fuels

Fuel is any material that can ignite and burn. Fuels describe any organic material, dead or alive, found in the fire environment. Grasses, brush, branches, logs, logging slash, forest floor litter, conifer needles, and home sites (the structures) are all examples. The physical properties and characteristics of fuels govern how fires burn. Fuel loading, size and shape, moisture content and continuity and arrangement all have an affect on fire behavior. Generally speaking, the smaller and finer the fuels, the faster the potential rate of fire spread. Small fuels such as grass, needle litter and other fuels less than a quarter inch in diameter are most responsible for fire spread. In fact, “fine” fuels, with high surface to volume ratios, are considered the primary carriers of surface fire. This is apparent to anyone who has ever witnessed the speed at which grass fires burn. As fuel size increases, the rate of spread tends to decrease, as surface to volume ratio decreases. Fires in large fuels generally burn at a slower rate, but release much more energy, and burn with much greater intensity. This increased energy release, or intensity, makes these fires more difficult to control. Thus, it is much easier to control a fire burning in grass than to control a fire burning in timber.

When burning under a forest canopy, the increased intensities can lead to torching (single trees becoming completely involved) and potentially development of crown fire. That is, they release much more energy. Fuels are found in combinations of types, amounts, sizes, shapes, and arrangements. It is the unique combination of these factors, along with the topography and weather, which determine how fires will burn.

The study of fire behavior recognizes the dramatic and often-unexpected affect small changes in any single component has on how fires burn. It is impossible to speak in specific terms when predicting how a fire will burn under any given set of conditions. However, through countless observations and repeated research, the some of the principles that govern fire behavior have been identified and are recognized.

4.2 Petroleum County Conditions

Petroleum County is characterized by cold winters and dry summers. Although fairly large, Petroleum County is sparsely populated, with a population density of less than one person per square mile (the lowest county population in Montana and the sixth lowest in the nation). Winnett represents the greatest concentration of population in the County. The remainder of the county is quite rural, due in large part to the agricultural economy of the region and the degreeof Federal land ownership. Farms and ranches tend to be widely spread throughout the County. Grazing activity on both public and private lands by livestock and wildlife tends to decrease the build up of fine fuel loads; however, this does not drastically reduce the fire potential.

In addition to homes, other economic resources could be threatened by wildland fire. Petroleum County sits atop valuable oil and gas reserves, particularly in the eastern portion of the county. Numerous active oil rigs dot the landscape, each rig being fed by electrical power lines. This creates a web of power lines throughout the dry rangelands. The number of power lines and oil rigs in the area somewhat increases the potential for electrical malfunctions and ignition sources.

Human activity is strongly correlated with fire frequency, with increasing numbers of fires as use increases. Discarded cigarettes, tire fires, and hot catalytic converters have increased the number of fires experienced along roadways. Careless and unsupervised use of fireworks also contributes their fair share to unwanted and unexpected wildland fires. Further contributing to ignition sources are the debris burners who use fire to rid ditches of weeds and other burnable materials.

4.2.1 County Wide Potential Mitigation Activities

There are four basic opportunities for reducing the loss of homes and lives to fires. There are many single actions that can be taken, but in general they can be lumped into one of the following categories:

- Prevention
- Education/ Mitigation
- Readiness
- Building Codes

4.2.1.1 Prevention

The safest, easiest, and most economical way to mitigate unwanted fires is to stop them before they start. Generally, prevention actions attempt to prevent human-caused fires. Campaigns designed to reduce the number and sources of ignitions can be quite effective. Prevention campaigns can take many forms. Traditional “Smokey Bear” type campaigns that spread the message passively through signage can be quite effective. Signs that remind folks of the dangers of careless use of fireworks, burning when windy, and leaving unattended campfires can be quite effective. It’s impossible to say just how effective such efforts actually are, however the low costs associated with posting of a few signs is inconsequential compared to the potential cost of fighting a fire.

Slightly more active prevention techniques may involve mass media, such as radio or the local newspaper. Fire districts in other counties have contributed the reduction in human-caused ignitions by running a weekly “run blotter,” similar to a police blotter, each week in the paper. The blotter briefly describes the runs of the week and is followed by a weekly “tip of the week” to reduce the threat from wildland and structure fires. The federal government has been a champion of prevention, and could provide ideas for such tips. When fire conditions become high, brief public service messages could warn of the hazards of misuse of fire or any other incendiary devise. Such a campaign would require coordination and cooperation with local media outlets. However, the effort is likely to be worth the efforts, costs and risks associated with fighting unwanted fires.

Fire Reporting: Fires cannot be suppressed until they are detected and reported. As the number and popularity of cellular phones has increased, expansion of the #FIRE program throughout Montana may provide an effective means for turning the passing motorist into a detection resource.

Burn Permits: The issues associated with debris burning during certain times of the year are difficult to negotiate and enforce. However, there are significant risks associated with the use of fire adjacent to expanses of flammable vegetation under certain scenarios. Burning permits are required by State law on all forested lands within the State during the official fire season of May 1 to September 30. The wildland fire agencies (DNRC, USFS, BLM, and US Fish and Wildlife Service) each have their own guidelines for issuing burn permits in their jurisdictions. Since local government fire agencies area also involved with burn permit regulation, close coordination between the two types of agencies is needed to ensure safe burning and to exchange information. Enforcement of burning permit requirements is the responsibility of the County Sheriff’s Department. Although this is a state-wide regulation, compliance and enforcement has been variable between fire districts. There is also considerable confusion on the part of the public as to when a permit is necessary and the procedure for which to obtain the permit. The best-intentioned citizen may unknowingly break this law for a lack of understanding. Clearly, there is a need to coordinate this process and educate the public.

Fire Resistant Oil Rig Sites: The occurrence of oil rig sites throughout central Montana is high. Although the fire risk associated with this machinery is low, the potential for an ignition due to mechanical failure or other reason exists. Maintaining fire resistant vegetation in the immediate vicinity of the rigs will decrease the likelihood of a stray spark igniting nearby fuels. A method for maintaining these sites with an awareness of the associated fire danger should be a priority of every county.

4.2.1.2 Education

Once a fire has started and is moving toward homes or other valued resources, the probability of that structure surviving is largely dependent on the structural and landscaping characteristics of the home. Also of vital importance is the accessibility of the home to emergency apparatus. If the home cannot be protected safely, firefighting resources will not jeopardize lives to protect a structure. Thus, the fate of the home will largely be determined by homeowner actions prior to the event.

The majority of the uncultivated vegetation in Petroleum County is comprised of timberlands. These fuels tend to be very flammable and can support very fast moving and intense fires. In many cases, homes can easily be protected by following a few simple guidelines that reduce the ignitability of the home. There are multiple programs such as FIREWISE that detail precautions that should be taken in order to reduce the threat to homes, such as clearing timber or cured grass and weeds away from structures and establishing a green zone around the home.

However, knowledge is no good unless acted upon. Education needs to be followed up by action. Any education programs should include an implementation plan. Ideally, funds would be made available to financially assist the landowner making the necessary changes to the home. The survey of the public conducted during the preparation of this WUI Fire Mitigation Plan indicated that approximately 52% of the respondents are interested in participating in this type of an activity.

4.2.1.3 Readiness

Once a fire has started, how much and how large it burns is often dependent on the availability of suppression resources. In most cases, rural fire departments are the first to respond and have the best opportunity to halt the spread of a wildland fire. For many districts, the ability to reach these suppression objectives is largely dependent on the availability of functional resources and trained individuals. Increasing the capacity of departments through funding and equipment acquisition can improve response times and subsequently reduce the potential for resource loss.

In order to assure a quick and efficient response to an event, emergency responders need to know specifically where emergency services are needed. Continued improvement and updating of the rural addressing system is necessary to maximize the effectiveness of a response.

4.2.1.4 Building Codes

The most effective, albeit contentious, solution to some fire problems is the adoption of building codes in order to assure emergency vehicle access and home construction that does not “invite” a fast and intense house fire. Codes that establish minimum road construction standards and access standards for emergency vehicles are an effective means of assuring public and firefighter safety, as well as increasing the potential for home survivability. County building inspectors should look to the fire departments in order to assure adequate minimum standards. Fire districts may want to consider apparatus that may be available during mutual aid events in

order that the adopted standards meet the access requirements of the majority of suppression resources. In Petroleum County, such standards may be drafted in consultation with the Fire Chiefs in order to assure accessibility is possible for all responding resources.

Coupled with this need is the potential to implement a set of requirements or recommendations to specify construction materials allowed for use in high risk areas of the county. The Petroleum County Commissioners may want to consider a policy for dealing with this situation into the future as more and more homes are located in the wildland-urban interface.

4.3 Petroleum County's Wildland-Urban Interface

Individual community assessments have been completed for all of the populated places in the county. The following summaries include these descriptions and observations. Local place names identified during this plan's development include:

Table 4.1. Petroleum County Communities

Community Name	Planning Description	Vegetative Community	National Register Community At Risk?[1]
Winnett	Community	Rangeland	Yes

[1]Those communities with a "Yes" in the National Register Community at Risk column are included in the Federal Register, Vol. 66, Number 160, Friday, August 17, 2001, as "Urban Wildland Interface Communities within the vicinity of Federal Lands that are at high risk from wildfires". All of these communities have been evaluated as part of this plan's assessment.

Site evaluations on these communities are included in subsequent sections. The results of FEMA Hazard Severity Forms for each community are presented in Appendix II.

4.3.1 Mitigation Activities Applicable to all Communities

4.3.1.1 Homesite Evaluations and Creation of Defensible Space

Individual home site evaluations can increase homeowners' awareness and improve the survivability of structures in the event of a wildfire. Maintaining a lean, clean, green zone within at least 100 feet of structures to reduce the potential loss of life and property is highly recommended. Assessing individual homes in the outlying areas can address the issue of escape routes and home defensibility characteristics. Educating the homeowners in techniques for protecting their homes is critical in these environments.

4.3.1.2 Travel Corridor Fire Breaks

Ignition points are likely to continue to be concentrated along the roads and railway lines that run through the county. These travel routes have historically served as the primary source of human-caused ignitions. In areas with high concentrations of resource values along these corridors, fire lines may be considered in order to provide a fire break in the event of a roadside ignition. Access route mitigation can provide an adequate control line under normal fire conditions. Alternatively, permanent fuel breaks can be established in order to reduce the potential for ignitions originating from the main travel roads to spread into the surrounding lands.

4.3.1.3 Power Line Corridor Fire Breaks

The treatment opportunities specified for travel corridor fire breaks apply equally for power line corridors. The obvious difference between the two is that the focus area is not an area parallel

to and adjacent to the road, but instead focuses on the area immediately below the infrastructure element. Protection under the high tension power lines is strongly recommended. This may be an opportunity for intensive livestock grazing practices as a tool for reducing fine fuels around significant infrastructure.

4.4 Rangeland Communities in Petroleum County

Community of Winnett, Oil fields, and Rural Ranches.

4.4.1 Overall Fuels Assessment

Much of the southern portion of Petroleum County is dominated by farmland, grassland or sagebrush-grassland. The harsh winters, low precipitation, short growing season, and periodic, severe drought limits establishment of trees throughout much of the southern portion of the county. Typical species in the sagebrush grassland ecosystem include sagebrush, bluebunch wheatgrass, blue gramagrass, needle and thread, Indian ricegrass, little bluestem, juniper, prairie sandreed, western wheatgrass, and crested wheatgrass. The grass and sage fuels in many areas tend to be relatively sparse and short, with little continuity, limiting fire spread in the absence of wind. Fires in rangeland fuels tend to burn at relatively low intensities, with moderate flame lengths and only short-range spotting. Suppression resources are generally quite effective in such fuels. Homes and other improvements can be easily protected from the direct flame contact and radiant heat through adoption of precautionary measures around the structure.

Although fires in these fuels may not present the same control problems as those associated with large, high intensity fires in timber fuel types, they can cause significant damage if precautionary measures have not taken place prior to a fire event. Wind driven fires in these shortgrass fuel types spread rapidly and can be difficult to control. During extreme drought and pushed by high winds, fires in these fuel types can exhibit extreme rates of spread, thwarting suppression efforts. The fires within the Missouri Breaks Complex of 2003 demonstrate the potential for fires in these fuels to grow to enormous size and demonstrate fire behavior atypical of these fuel complexes.

Farming and ranching activity has broken native fuel continuity at a landscape scale in portions of Petroleum County. Irrigated yards, agricultural fields, roads and grazed pastureland help to break the continuity and serve as fuel breaks, providing opportunities to control the spread of wildland fires. However, in more remote areas of Petroleum County, large continuous tracts of prairie are typical, with few breaks in fuel continuity.

The Charles M. Russell National Wildlife Refuge is an example of one of these large areas of continuous fuel. The refuge is located along the Missouri Breaks in the northern portion of Petroleum County. The entire refuge covers 1,100,000 acres and extends for approximately 125 air miles, only a portion of which lies within Petroleum County. Much of the refuge is covered by native prairie grasses, forested coulees, and pine savannahs. The combination of continuous fuels, varied topography, and windy environment would likely support a fast-moving wildfire, as demonstrated further east in the refuge in the summer of 2003.

Forested vegetation, although scattered throughout the entire county, is most concentrated in the north, and north central portions of the county. Forest establishment is typically restricted to areas with more fertile soils or in areas where moisture availability is not as limited. Where forests due occur, they tend to be dry, low productivity ponderosa pine forest types, with a component of Rocky Mountain juniper.

Historically, these forest types consisted of fire maintained grasslands under a ponderosa pine overstory. Summer lightning storms and use by indigenous peoples provided abundant ignition

sources. Historic fire frequency was from 5 to 25 years, generally burning at low to moderate intensities. These fires helped to reduce juniper encroachment and limit survival of pine regeneration, thus maintaining a relatively open understory. However, with the advent of fire suppression, juniper establishment has increased, as have thickets of ponderosa pine.

In a number of areas throughout the county, forest conditions are typically multistoried and overstocked with young pine and juniper. This condition is especially true on north slopes. Increased activities by pathogens will continue to increases levels of dead and down fuel, as host trees succumb to insect attack and stand level mortality increases. Overstocked, multi-layered stands and the abundance of pine and juniper ladder fuels leads to horizontal and vertical fuel continuity in many stands. These conditions, combined with an arid and often windy environment, can encourage the development of stand replacing fire. These fires can present control problems and develop into large, destructive wildland fires. Examples of such large fires can be seen in areas throughout the county.

4.4.2 Overall Ignition Profile

The dry climate, xeric vegetation, and prevalence of hot and windy conditions in Petroleum County create environmental and vegetative conditions that will sustain fire spread for many months of the year. This increases the probability that ignition sources from both natural (lightning) and human causes will find a receptive fuel bed. Natural ignitions are most likely to occur during summer storms over the high ridges and timbered areas in the north of the County. Although not quite as common as over the mountains, lighting strikes do occur in rolling southern portion of the County. Lightning strikes in light fuels are frequently extinguished quickly if any precipitation accompanies the storm. Natural ignitions are more common in forested areas, where trees and downed woody fuels are able to sustain fire during precipitation events, emerging hours or days later when surface fuels again dry. However, during dry lightning events, storm cells can ignite dozens of fires throughout forested or rangeland areas.

Human ignitions can stem from numerous activities, including debris burning, fireworks, cigarettes, welding, campfires, particularly in the Charles Russell NWR where recreation use is concentrated. Included in human ignition sources are fires sparked by vehicles or hot catalytic converters. Also included in an ignition profile are the fires sparked by downed power lines or malfunctioning transformers. All these potential ignition sources and the dry nature of vegetation in Petroleum County increase the potential for fire occurrence.

4.4.3 Individual Community Assessments

4.4.3.1 Winnett

The small community of Winnett is located near the center of Petroleum County at the intersection of State Highway 200 and State Highway 244. This area is entirely privately owned except for a parcel managed by the State of Montana northwest of town. McDonald Creek flows from east to west near the city center providing irrigational resources for many homeowners positioned in the broad drainage bottom.

4.4.3.1.1 Community Risk Assessment

Winnett is surrounded by the vast and gently rolling rangeland typical throughout Petroleum County. Although there are several homes around the town site, many large farm and ranch structures are scattered through the surrounding area. Almost all of these landowners have developed the ground surrounding these structures for agricultural use or pasture for livestock.

Additionally, irrigated lawns surround most home sites. A steep, rim rock ridge rises along the southeastern edge of the city center. The flat top of this formation is vegetated by various shortgrass species; however, there is no vegetation along the face or in the pile of rock rubble at the base. The lack of hazardous vegetation and relative isolation of this distinguishing feature of the community does not introduce substantial fire risk.

A small patch of native vegetation, mostly grass, along the south end of town has been left undeveloped. Evidence of off-road vehicle travel in this area can be seen. This activity increases the potential for a fire start in the fine grass fuels. Winnett is separated from these fuels by a paved roadway, which would serve as an effective fuel break; thus, the fire risk to the community is low.

The primary access into Winnett is provided by both State Highway 200 and State Highway 244. Both of these paved highways travel through areas considered to be at low fire risk. There are also a few other secondary roads such as Cemetary Road and Dovetail-Valentine Road that offer additional escape routes.

House numbers on rural homes throughout the area are generally difficult to see; however, names of landowners and mileage to structures are usually posted at road intersections. Many outlying homes have been built at the end of long, single-lane, dead end private driveways. One-way in, one-way out access roads are unsafe for both residents and firefighters due to the risk of becoming trapped and the inability of emergency vehicles to pass each other. Structures around the community of Winnett are generally all or partially constructed with building materials unfavorable for protection against wildfire. Structural fire protection is provided by the Winnett Fire Department.

The overall risk posed by a wildfire event to the community of Winnett is low. This is due to the inconsistency of native vegetation in the area and the low intensities associated with fire in these fuel types. The possibility of a rangeland fire does certainly exist. The potential for human caused ignitions in the area is moderate due to the low population of the area. A fire in the fine grass fuels surrounding Winnett would tend to spread rapidly under the influence of wind, but would burn at relatively low intensities. Suppression resources are generally quite effective in these fuel types. Additionally, the low intensities and short flame lengths would not present a significant threat to most structures in the community.

4.4.3.1.2 Mitigation Activities

Educating the homeowners in techniques for protecting their homes can help further reduce the potential for damage from range or grass fires. Individual home site evaluations can increase homeowners' awareness and provide the impetus to reduce the ignition potential of structures in the event of a wildfire. Maintaining a lean, clean, green zone around structures is the most effective means of protection against a wildland fire in these fuel types. In cases where cedar shakes or wood siding and decking have been used in home construction, there are no easy solutions to reduce the vulnerability to fire. In the future, homeowners should consider re-roofing with fire resistant materials. Finally, reducing the response time for emergency resources allows fires to be controlled quickly, before they pose a threat to homes and resources. Measures that ease location of and access to an emerging fire further reduces the potential for loss. Creating and mapping drafting sites and alternate water sources such as underground tanks near the community will increase the efficiency and effectiveness of fire suppression.

4.4.3.2 Rural Homes and Ranches

4.4.3.2.1 Risk Assessment

The vast majority of occupied homes and ranches throughout Petroleum County are at relatively low risk to wildland fire. The low risk is due in large part to the predominant land use surrounding homes, barns and outbuildings. Actively managed agricultural lands surround most ranch sites, which can provide a buffer from fire, especially if irrigated. In many cases, bare soil surrounds many of the barns and outbuildings due to use by domestic livestock and day-to-day ranching operations. Well-irrigated, green lawns surround most homes, with very little flammable vegetation in the vicinity of structures. Furthermore, most ranches and rural home sites are located on flat terrain, reducing the slope effect in fire spread.

The structures at greatest risk to loss are remote outbuildings around which dried grass and weeds have been allowed to accumulate. Many remote outbuildings lack a defensible space, and in many cases have dried fuels in direct contact with the structure.

Emergency response times may be extended due to the great distances between farms and ranches and fire stations. Extended response times increases the need for homeowners to take necessary precautions to guard against fire risk. In general, most farm and ranch operations have access to tractors and other implements that can be used to control wildland fire spread, somewhat offsetting the risk associated with the increased response time. This is not true for the scattered recreational homes used only seasonally.

4.4.3.2.2 Mitigation Activities

Educating the home and ranch owners in techniques for protecting their investments can further reduce the potential for loss in the event of an unexpected fire event. Individual home site evaluations can increase homeowners' awareness and provide the impetus to reduce the ignition potential of structures in the event of a wildfire. Maintaining a non-flammable zone around structures is the most effective means of protection against a wildland fire in these fuel types. This is particularly important around wooden structures such as barns and outbuildings, as these materials are much more vulnerable to combustion from radiant heating. Finally, reducing the response time for emergency resources allows fires to be controlled quickly, before they pose a threat to homes and resources. Measures that ease location of and access to an emerging fire further reduces the potential for loss.

4.4.3.3 Oil Fields

4.4.3.3.1 Risk Assessment

Located in the county are several active oil fields with many oil wells in each field. One set of fields is located on the eastern half of the county, off of the Cat Creek road. The other field is in the west half of the county off of hwy 200 near Teigen. These fields are usually comprised of several different oils wells that pump oil directly to centrally located storage tanks. Tankers come by periodically to collect the oil and haul it to refineries in Helena, Montana. None of the wells are pressurized, so the oil must be mechanically brought to the surface. If a well were to catch on fire only the oil in and around the well head could burn. In most cases this would be limited to less than 5 gallons.

Access to and around the oil fields is very good as large equipment is often operating in the area.

Over the lifetime operation of the oil fields small spills have occurred. In many areas, especially near the oil wells and storage tanks, the soil contains a high absorption of oil. This oil is in a tar like state and does not easily burn. The electric motors and rubber belts used to power the wells are would be vulnerable to fire burning near or over the pumps.

The terrain where the fields are located is generally flat with some small draws or canyons in the area. The flat topography means that most fire behavior, speed, and direction is wind dependant.

The fields at greatest risk to loss are those in which dried grass and weeds have been allowed to accumulate. Moderately flammable vegetation was noted in the vicinity of most oil fields. There are currently no pro-active measures to keep the areas around the oil fields free of flammable vegetation. In many cases this vegetation abuts tanks and oil wells.

Fire protection response times may be extended due to the distances between fields and fire stations. Emergency services response time increases the need for oil field owners to take necessary precautions to guard against fire risk. In general, most fields have access to tractors and other implements that can be used to control wildland fire spread. Owner/operators live close to the fields and are near enough to the field to provide a quick response.

4.4.3.3.2 Mitigation Activities

Educating oil field owners and operators in techniques for protecting their investments can reduce the potential for loss in the event of an unexpected fire. Maintaining a non-flammable zone around oil wells and tanks is the most effective means of protection against a wildland fire in these fuel types

4.5 Fire Fighting Resources and Capabilities

The Fire Fighting Resources and Capabilities information provided in this section is a summary of information provided by the Petroleum County Cooperative Fire Management Plan and the Rural Fire Chiefs or Representatives of the Wildland Fire Fighting Agencies listed. Their answers to a variety of questions are summarized here. ***In an effort to correctly portray their observations, little editing to their responses has occurred.*** These summaries indicate their perceptions and information summaries.

4.5.1 Wildland Fire Districts

4.5.1.1 Montana Department of Natural Resources and Conservation

Lewistown Northeastern Land Office
406-538-7789

Available Resources:

Aircraft:

- Recon flights available with a County Fire Advisor if warranted and weather conditions permit
- Retardant aircraft available if warranted and weather conditions permit

Ground Resources:

- 15 programmable King portable radios

- 50-person mobile fire cache
- Mobile command trailer
- DSL-376 4x4 1-ton flatbed
- DSL-353 ½ ton 4x4 pickup
- DSL-838 ½ ton 4x4 pickup
- DSL-842 ½ ton 4x4 pickup
- DSL-919 ½ ton 4x4 pickup (IC for CAT team)
- DSL-257 ½ ton 4x4 pickup (IOFR for CAT team)

4.5.1.2 Bureau of Land Management

The Central Zone's fire suppression/operations resources are based in Lewistown at the Central Zone Fire Complex located at the Lewistown Airport, and the Little Rockies Fire Station located just north of Zortman, Montana.

In addition to BLM lands, the Central Zone is also responsible by agreement for initial attack on USFS lands in the Big and Little Snowy Mountains (Musselshell & Judith Ranger Districts). We also provide initial attack on wildland fires, under offset agreements for parts of Blaine, Phillips and Valley Counties. Lewistown Interagency Dispatch (LID) will be responsible for all IA dispatching functions.

Lewistown Interagency Dispatch Center
406-538-7461

The current list of resources includes:

- Zone FMO
- Zone AFMO
- Lewistown FOS
- Zone Warehouse Manager
- Helicopter Module (7 person)
- Single Engine Air tanker Manager
- 1 type 4 Engine w/ 7 person crew
- 3 type 6 Engines w/ 5 person crew
- 1 type 1 water tender w/ 2 person crew
- 1 exclusive use Air Attack platform w/collateral duty or detailed ATGS
- 1 CWN Single Engine Air tanker as needed
- 1 exclusive use Type III helicopter (mid July-September)
- Personnel – 36

Additional resources located in Zortman, Montana:

- Zortman FOS
- 1 type 4 Engine w/ 7 person crew
- 2 type 6 Engines w/ 5 person crew
- Personnel – 18

4.5.1.3 US Fish & Wildlife Service (Charles M. Russell NWR-Sand Creek Resources)

Table 4.2. USFWS Wildfire Equipment

Item	Year Purchased	Number	GVW
Engine Type			
4x-heavy (500-1000 gal)	1997	1	25,000/32,000
6x-medium (200-400 gal)	1990, 2000	2	12,000/15,000
7x-light (50-150 gal)	2002	1	12,000/15,000
Slip-on units	N/A		
Water Tenders	N/A		
Portable Pumps			
Standard	1995-1999	2	
Float-a-pump	1997-1999	1	
Power Saws	Various	4	
Graders	2003	1	
ATVs—4 wheel	2004	2	
Radios			
Narrow band portable	1996-2000	20	
Narrow band mobile	1996-2000	15	

All engines are outfitted with the required minimum gear to support local fire operations. The Refuge has six Type 6 engines and one Type 4 engine. These engines are outfitted with a full accompaniment of equipment as outlined in the WNCG Fireline Handbook (PMS 410-1) and the Northern Rockies Coordination Group interagency standards for Type 4 & 6 engines in this geographic area.

The USFWS (CMR Sand Creek Resources) also has 6 seasonal Firefighters along with Paul Pallas, AFMO and Ben Pratt, Supervisory Range Tech at Sand Creek.

4.5.2 Rural Fire Districts

4.5.2.1 Winnett Volunteer Fire Department

Leonard Eickoff, Chief
Winnett Volunteer Fire Department
108 S. Broadway
P.O. Box 38
Winnett, Montana 59087
karloff@midrivers.com
406-429-6116

The Winnett Volunteer Fire Department covers the community of Winnett and all of Petroleum County.

Priority Areas:
Residential Growth - There are three subdivisions east of Winnett along the Musselshell River that are at higher risk due to the greater response time required. Recently, there has been an

increase in the number of structures along the northern reaches of the County. Many of these are non-resident cabins. Structures in northern Petroleum County are at greater risk of experiencing a wildland fire due their closer proximity to the Charles M. Russell National Wildlife Refuge and denser vegetation.

Fire Fighting Equipment – Current tenders and the city truck are older models that will need to updated.

Burn Permit Regulations – Petroleum County has burning regulations in place, but there are some issues with people not abiding.

Effective Mitigation Strategies: The Winnett VFD has received a few state grants in the past; however, additional grant monies are needed to provide additional resources in more remote regions of the county.

Education and Training: Continue fire prevention program at Winnett High School and Ross Rural School. Also, continue training with fire department members.

Cooperative Agreements: The County has mutual aid agreements with surrounding counties and state lands. There are also verbal agreements with the BLM and CMR.

Available Resources:

- 1968 Kaiser 5-ton 1,600 gallon 6x6 water tender (Type 6)
- 2002 Ford 1 ½ ton 4x4 400 gallon engine (Type 6)
- 2003 Ford 1 ton 4x4 300 gallon engine (Type 6)
- 1980 AMG 2 ½ ton 1,100 gallon 6x6 water tender (Type 6)
- 1960 International 500 gallon engine (Type 3)

Table 4.3. Remote Units in Petroleum County (part of Winnett VFD).

Resource	Location	Ownership
200 gallon engine	Iverson Ranch	State
200 gallon engine	Tiegen Land & Livestock	State
200 gallon engine	Mosby	State
500 gallon engine	Lund Ranch	State

Current Needs: One of the major needs is to get younger people involved with fire fighting and involvement with the fire department. We feel our prevention program is helping with this and also our involvement with the community.

Sometime in the future, we would like to have access to equipment that will make it easier to fight fire in hard to reach areas with our vehicles, such as all terrain vehicles. We would also like to see a fire station in the northern part of the county. Many of our fires are in this area. Our response time would be much faster. We feel this need is important with the growth of the subdivision and more hunting lodges being built.

- Heated garage for trucks and ambulance
- Update 1960 city engine
- Recruit more young volunteers

- 5,000 gallon tanker trailer with pump attached
- Permanent water source at northern end of the County

4.5.2.1.1 Petroleum County Support Equipment

Gary Allen
Petroleum County Shop Foreman
406-429-7371

- 2 John Deere graders
- Cat 936 front end loader
- Case 580 wheel loader
- 2 white freightliner semi truck tractors
- Dump truck
- 2 pickup trucks
- Equipment trailer
- Fuel truck
- Floater pump

4.6 Issues Facing Petroleum County Fire Protection

4.6.1 Rural Cabins and Ranches

Many residents of Petroleum County operate rural ranches scattered randomly throughout the area. For the most part these landowners have tractors or other implements to protect their homes and structures in the event of a wildland fire. Recently, Petroleum County has experienced an influx of rural cabins and lodges being built by non-residents. These structures are typically used only on a seasonal basis; thus, a wildland fire in their vicinity may not be reported immediately. Additionally, it is unlikely that these homeowners would have a maintained defensible space during the off-season or tools to protect their structures from wildfire. The Winnett Volunteer Fire Department has established remote locations for fire response vehicles to help assuage their response time to the farther reaches of the County.

4.7 Current Wildfire Mitigation Activities in Petroleum County

4.7.1 Bureau of Land Management

Assistance activities potentially cover 14 counties within the Lewistown Field Office. Assistance to communities focuses on fire hazard assessment and mitigation planning, hazardous fuel reduction, natural resource-based economic development, fire education and Rural Fire Assistance.

Assistance agreements for assessments, planning, hazardous fuel reduction and landowner education have been signed with four county entities (Fergus, Chouteau, Lewis and Clark, and Teton counties) and one economic development council that covers three counties (Judith Basin, Fergus and Petroleum counties) within the field office area.

Projects currently underway through the assistance agreements include hazardous fuel reduction in Fergus, Chouteau and Lewis and Clark counties; county-wide fire mitigation assessment and planning in Fergus, Judith Basin, Petroleum, Chouteau and Teton counties; individual community assessments in Lewis and Clark county; education and outreach to landowners in Judith Basin, Fergus and Petroleum counties.

The potential for biomass energy development is currently being pursued for school and medical facilities in Lewistown (Fergus County) and for schools in Judith Basin County. Such a project has the potential to result in energy savings for public buildings, create a market for natural resource small business, and tie in with hazardous fuel reduction plans on federal lands for both BLM and the U.S. Forest Service.

Chapter 5: Treatment Recommendations

5 Overview

Critical to the implementation of this Wildland-Urban Interface Wildfire Mitigation Plan will be the identification of, and implementation of, an integrated schedule of treatments targeted at achieving an elimination of the lives lost, and reduction in structures destroyed, infrastructure compromised, and unique ecosystems damaged that serve to sustain the way-of-life and economy of Petroleum County and the region. Since there are many land management agencies and hundreds of private landowners in Petroleum County, it is reasonable to expect that differing schedules of adoption will be made and varying degrees of compliance will be observed across all ownerships.

The Federal land management agencies in Petroleum County, specifically the USDA Forest Service and the Bureau of Land Management, the USDI Fish and Wildlife Service, and the state land management agency, the Montana Department of Natural Resources and Conservation, are participants in this planning process and have contributed to its development. Where available, their schedule of WUI treatments has been summarized in this chapter to better facilitate a correlation between their identified planning efforts and the efforts of Petroleum County.

5.1 Possible Fire Mitigation Activities

As part of the implementation of fire mitigation activities in Petroleum County, a variety of management tools may be used. Management tools include but are not limited to the following:

- Homeowner and landowner education
- Building code changes for structures and infrastructure in the WUI
- Home site defensible zone through fuels modification
- Community defensible zone fuels alteration
- Access improvements
- Access creation
- Emergency response enhancements (training, equipment, locating new fire stations, new fire districts, merging existing districts)
- Regional land management recommendations for private, state, and federal landowners

Maintaining private property rights will continue to be one of the guiding principles of this plan's implementation. Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity. Net gains to the public benefit will be an important component of decisions.

5.2 WUI Safety & Policy

Wildfire mitigation efforts must be supported by a set of policies and regulations at the county level that maintain a solid foundation for safety and consistency. The recommendations enumerated here serve that purpose. Because these items are regulatory in nature, they will not necessarily be accompanied by cost estimates. These recommendations are policy related in

nature and therefore are recommendations to the appropriate elected officials; debate and formulation of alternatives will serve to make these recommendations suitable and appropriate.

As part of the Policy of Petroleum County in relation to this planning document, this entire **Wildland-Urban Interface Wildfire Mitigation Plan** should be reviewed annually at a special meeting of the Petroleum County Commissioners, open to the public, where action items, priorities, budgets, and modifications can be made or confirmed. A written review of the plan should be approved by the Chairman of the County Commissioners, detailing plans for the year's activities, and made available to the general public ahead of the meeting. Amendments to the plan should be detailed at this meeting, documented, and attached to the formal plan as an amendment to the WUI Wildfire Mitigation Plan (signatures by the cooperators would be collected at the Chairman's discretion). Re-evaluation of this plan should be made on the 5th anniversary of its acceptance, and every 5-year period following.

Prioritization of activities recommended in this plan should be made by the Petroleum County Commissioners consistent with the recommendations made in Chapter 1 of this document. During the annual review of this plan, reprioritization can be justified in response to changing conditions and funding opportunities.

5.2.1 Existing Practices That Should Continue

Petroleum County currently is implementing many projects and activities that, in their absence, could lead to increased wildland fire loss potential. By enumerating some of them here, it is the desire of the authors to point out successful activities.

- Existing rural addressing efforts have aided emergency responses well.
- Rural land management for Agriculture and Livestock has served fuels reduction greatly.

5.2.2 Proposed Activities

Table 5.1. WUI Action Items in Safety and Policy.

Action Item	Goals and Objectives	Responsible Organization	Action Items & Planning Horizon
5.1.a: Amend existing building codes to apply equally to new single housing construction as it does to sub-divisions. Make sure existing policy is comprehensive to wildland fire risks.	**Protection of people and structures** by applying a standard of road widths, access, and building regulations suitable to insure new homes can be protected while minimizing risks to firefighters. (defensible space, roads and access management, water systems, building codes, signage, and maintenance of private forest and range lands)	**County Commissioners** in cooperation with Rural Fire District and Planning and Zoning.	• Year 1 debate and adoption of revised code (2004). • Review adequacy of changes annually, make changes as needed.
5.1.b: Develop County policy concerning building materials used in high-risk WUI areas on existing structures and new construction	**Protection of people and structures** by improving the ability of emergency response personnel to respond to threatened homes in high-risk areas.	**County Commissioners Office** in cooperation with Rural Fire Departments	**Year 1 (2004) activity:** Consider and develop policy to address construction materials for homes and businesses located in high wildfire risk

Table 5.1. WUI Action Items in Safety and Policy.

Action Item	Goals and Objectives	Responsible Organization	Action Items & Planning Horizon
(including recreational use cabins)			areas. Specifically, a County policy concerning wooden roofing materials and flammable siding, especially where juxtaposed near heavy wildland fuels.
5.1.c: Develop a County Commissioner's Office policy to support the applications for grant monies for projects resulting from recommendations in this plan.	**Protection of people and structures** by improving the ability of residents and organizations to implement sometimes costly projects.	**County Commissioners Office**	**Ongoing activity:** Support grant applications as requested in a manner consistent with applications from residents and organizations in Petroleum County.
5.1.d: Create a permanent advisory committee to serve the County Commissioners in issues related to wildland fire issues. "Wildland-Urban Interface Wildfire Advisory Committee"	**Protection of people and structures** by improving the ability of residents and organizations to respond to wildland fire issues facing Petroleum County.	**County Commissioners Office**	**Ongoing activity:** Create an advisory committee to meet annually and periodically to assist the commissioners in developing policies and responses to issues concerning wildland fire.
5.1.e.: Develop a local procedure to record and document all wildland fire ignitions in Petroleum County.	**Protection of people and structures** by improving information collection about wildfires in Petroleum County.	**County Commissioners Office** working with Rural Fire Department and Fergus County Planning Department's GIS Lab.	**Ongoing activity:** Develop and implement a procedure to record and maintain a GIS database of wildfire ignitions, acres burned, and cause of fires.

5.3 People and Structures

The protection of people and structures will be tied together closely as the loss of life in the event of a wildland fire is generally linked to a person who could not, or did not, flee a structure threatened by a wildfire. The other incident is a fire fighter who suffers the loss of life during the combating of a fire. Many of the recommendations in this section will define a set of criteria for implementation while others will be rather specific in extent and application.

Many of the recommendations in this section involve education and increasing awareness of the residents of Petroleum County. These recommendations stem from a variety of factors including items that became obvious during the analysis of the public surveys, discussions during public meetings, and observations about choices made by residents living in the Wildland-Urban Interface. Over and over, a common theme was present that pointed to a situation of landowners not recognizing risk factors:

- Homeowners in the public mail survey ranked their home site wildfire risk factors slightly lower than the sample of home rankings completed by fire mitigation specialists.
- Fire District personnel pointed to numerous examples of inadequate access to homes of people who believe they have adequate ingress.
- Discussions with the general public indicated an awareness of wildland fire risk, but they could not specifically identify risk factors.

- Over half of the respondents to the public mail survey indicated (52%) that they want to participate in educational opportunities focused on the WUI and what they can do to increase their home's chances of surviving a wildfire.

In addition to those items enumerated in Table 5.1, residents and policy makers of Petroleum County should recognize certain factors that exist today, that in their absence would lead to an increase in the risk factors associated with wildland fires in the WUI of Petroleum County. These items listed below should be encouraged, acknowledged, and recognized for their contributions to the reduction of wildland fire risks:

- **Livestock Grazing** in and around the communities of Petroleum County has led to a reduction of many of the fine fuels that would have been found in and around the communities and in the wildlands of Petroleum County. Domestic livestock not only eat these grasses, forbs, and shrubs, but also trample certain fuels to the ground where decomposition rates may increase. Livestock ranchers tend their stock, placing resource professionals into the forests and rangelands of the area where they may observe ignitions, or potentially risky activities. There are ample opportunities throughout the county to increase grazing. This could contribute to the economic output of the county as well as reduce the fuel loading. Livestock grazing in this region should be encouraged into the future as a low cost, positive tool of wildfire mitigation in the Wildland-Urban Interface and in the wildlands.

- **Rangeland Health*:*** Much of the area within Petroleum County is declining in health and at increased risk to large scale, high intensity wildland fire due to overcrowding by both pine and juniper regeneration. Current stand trajectory will lead to further decline in health, with continued accumulation of dead and downed woody fuels and further development of multistoried forest conditions and ladder fuels that can lead to intense wildland fire. Such fires can have severe and lasting impacts on water quality and slope stability due to loss of vegetative ground cover, as well as lead to loss of quality habitat for a variety of wildlife species.

  In order to reduce the potential for destructive wildland fire and to redirect stand trajectory, a hazardous fuel treatment program integrating commercial thinning, manual fuel treatments, and fuel breaks are recommended. Such an effort would likely require collaboration between multiple landowners, including private individuals, the State of Montana, the BLM and the US Fish and Wildlife Service. Similar analyses have already been completed on BLM lands in the Horsethief Hazardous Fuels Reduction Project in the Roundup area. The Horsethief Project addresses many of the same vegetation issues found on lands across ownerships in Petroleum County. This analysis may serve as a template for project development across ownership boundaries throughout Petroleum County.

- **Agriculture** is a significant component of Petroleum County's economy. The original conversion of these lands to agriculture from rangeland, was targeted at the most productive soils and juxtaposition to infrastructure. Many of these productive ecosystems were consequently also at some of the highest risk to wildland fires because biomass accumulations increased in these productive landscapes. The result today, is that much of the rangeland historically prone to frequent fires, has been converted to agriculture, which is at a much lower risk than prior to its conversion. The preservation of a viable agricultural economy in Petroleum County is integral to the continued management of wildfire risk in this region.

Table 5.2. WUI Action Items for People and Structures.

Action Item	Goals and Objectives	Responsible Organization	Action Items, Planning Horizon and Estimated Costs
5.2.a: Youth and Adult Wildfire Educational Programs	**Protect people and structures** by increasing awareness of WUI risks, how to recognize risk factors, and how to modify those factors to reduce risk	Cooperative effort including: • Montana State University Extension Service • Montana Department of Natural Resources and Conservation • Charles M. Russell National Wildlife Refuge • Bureau of Land Management • Local School Districts	Evaluate effectiveness of currently funded County education programs. If possible, use existing educational program materials and staffing. These programs may need reformatted using FireWISE materials. Formal needs assessment should be responsibility of Extension Service faculty and include the development of an integrated WUI educational series by year 3 (2006). Costs initially to be funded through existing budgets for these activities to be followed with grant monies to continue the programs as identified in the formal needs assessment. Detailed information regarding home defensible space requirements is contained on the FireWise CD, which can be purchased and personalized by the County. The CD costs $2,500.
5.2.b: Wildfire risk assessments of homes in Rural lands of Petroleum County	**Protect people and structures** by increasing awareness of specific risk factors of individual home sites in the at-risk landscapes. Only after these are completed can home site treatments follow.	To be implemented by **County Commissioners Office** in cooperation with the **Rural Fire Department**. Actual work may be completed by Wildfire Mitigation Consultants or trained volunteers.	• **Cost:** Approximately $100 per home site for inspection, written report, and discussions with the homeowners. • There are approximately 300 housing units in Petroleum County, roughly 200 (66%) of these structures would benefit from a home site inspection and budget determination for a total cost estimate of $20,000. • **Action Item:** Secure funding and contract to complete the inspections during years 1 & 2 (2004-05) • Home site inspection reports and estimated budget for each home site's treatments will be a requirement to receive funding for treatments through grants.
5.2.c: Home Site WUI Treatments	**Protect people, structures, and increase fire fighter safety** by reducing the risk factors surrounding homes in the WUI of Petroleum County	**County Commissioners** in cooperation with Fire Mitigation Consulting company and Rural Fire Districts *Complete concurrently with 5.4.b.*	• Actual funding level will be based on the outcomes of the home site assessments and cost estimates • **Estimate** that treatments will cost approximately $1,000 per home site for a defensible space of roughly 100-150'. Approximately 200 homes in this category for an estimated cost of $200,000. Total home and business (non-governmental) assessed value in County is $8,193,141 (Land assessed value of $3,909,231) (average $20,586): **B/C Ratio of this treatment is approximately 41:1**, when considered across the entire county (20:1 B/C ratio per treated structure). Actual B/C ratio will vary.

Table 5.2. WUI Action Items for People and Structures.

Action Item	Goals and Objectives	Responsible Organization	Action Items, Planning Horizon and Estimated Costs
			• Home site treatments can begin after the securing of funding for the treatments and immediate implementation in 2004 and will continue from year 1 through 5 (2008).
5.2.d: Community Defensible Zone WUI Treatments	**Protect people, structures, and increase fire fighter safety** by reducing the risk factors surrounding high risk communities in the WUI of Petroleum County	**County Commissioners** in cooperation with Fire Mitigation Consultants and Rural Fire Districts	• Actual funding level will be based on the outcomes of the home site assessments and cost estimates. • **Years 2-5 (2004-08):** Treat high risk wildland fuels from home site defensible space treatments (5.4.c) to an area extending 400 feet to 500 feet beyond home defensible spaces, where steep slopes and high accumulations of risky fuels exist. Should link together home treatment areas. Treatments target high risk concentrations of fuels and not 100% of the area identified. To be completed only after or during the creation of home defensible spaces have been implemented. • **Communities and areas to target:** Winnett, Flatwillow, and subdivisions along Musselshell River and Fort Peck Lake. • Approximate average cost on a per structure basis is $750 depending on extent of home defensibility site treatments, for a cost estimate of $150,000. Couple this cost with the home defensibility space costs of $200,000. The number of structures to benefit from these treatments include both homes and businesses (assessed value of $8,193,141). The **average B/C Ratio for these treatments combined in Petroleum County is 23:1**. Actual B/C ratio by community will be variable.
5.2.e: Maintenance of Home Site WUI Treatments	**Protect people, structures, and increase fire fighter safety** by reducing the risk factors surrounding homes in the WUI of Petroleum County	**County Commissioners Office** in cooperation with Rural Fire Departments and local home owners	• Home site defensibility treatments must be maintained periodically to sustain benefits of the initial treatments. • Each site should be assessed 5 years following initial treatment • Estimated re-inspection cost will be $50 per home site on all sites initially treated or recommended for future inspections ($10,000) • Follow-up inspection reports with treatments as recommended years 5 through 10.
5.2.f: Re-entry of Home Site WUI Treatments	**Protect people, structures, and increase fire fighter safety** by reducing the risk factors surrounding homes.	**County Commissioners Office** in cooperation with Rural Fire Departments and local home owners	• Re-entry treatments will be needed periodically to maintain the benefits of the initial WUI home treatments. Each re-entry schedule should be based on the initial inspection report recommendations, observations, and changes in local conditions. Generally occurs every 5-10 years.

Table 5.2. WUI Action Items for People and Structures.

Action Item	Goals and Objectives	Responsible Organization	Action Items, Planning Horizon and Estimated Costs
5.2.g: Access Improvements of bridges, cattle guards, and limiting road surfaces	**Protection of people, structures, infrastructure, and economy** by improving access for residents and fire fighting personnel in the event of a wildfire. Reduces the risk of a road failure that leads to the isolation of people or the limitation of emergency vehicle and personnel access during an emergency.	**County Roads and Bridges Department** in cooperation with US Forest Service, BLM, State of Montana (Dept. of Transportation), and forestland or rangeland owners.	• **Year 1 (2004):** Update existing assessment of travel surfaces, bridges, and cattle guards in Petroleum County as to location. Secure funding for implementation of this project (grants) • **Year 2 (2005):** Conduct engineering assessment of limiting weight restrictions for all surfaces (e.g., bridge weight load maximums). Estimate cost of $10,000 which might be shared between County, BLM, State, and private based on landownership associated with road locations. • **Year 2 (2005):** Post weight restriction signs on all crossings, copy information to rural fire districts and wildland fire protection agencies in affected areas. Estimate cost at roughly $10-$15,000 for signs and posting. • **Year 3 (2006):** Identify limiting road surfaces in need of improvements to support wildland fire fighting vehicles and other emergency equipment. Develop plan for improving limiting surfaces including budgets, timing, and resources to be protected for prioritization of projects (benefit/cost ratio analysis). Create budget based on full assessment.
5.2.h: Access Improvements through road-side fuels management.	**Protection of people, structures, infrastructure, and economy** by improving access for residents and fire fighting personnel in the event of a wildfire. Allows for a road based defensible area that can be linked to a terrain based defensible areas.	**County Roads and Bridges Department** in cooperation with US Forest Service, BLM, State of Montana (Dept. of Transportation), and forestland or rangeland owners.	• **Year 1 (2004):** Update existing assessment of roads in Petroleum County as to location. Secure funding for implementation of this project (grants). • **Year 2 (2005):** Specifically address access issues listed in column one, plus recreation areas, and others identified in assessment. Target 100' on downhill side of roads and 75' on uphill side for estimated cost of $7,500 per mile of road treated. If 150 miles of roadway are prioritized for treatment (est.) the cost would amount to $1,125,000. Total assessed value of land and structures in Petroleum County is $43,082,462. **B/C Ratio of 38:1 is achieved**, but is highly variable. Further, the total value of assets in the county is not "protected" by this type of treatment, its protection is "enhanced". • **Year 3 (2006):** Secure funding and implement projects to treat road-side fuels.

5.4 Infrastructure

Significant infrastructure refers to the communications, transportation (road and rail networks), energy transport supply systems (gas and power lines), and water supply that service a region or a surrounding area. All of these components are important to Petroleum County. These networks are by definition a part of the Wildland-Urban Interface in the protection of people, structures, **infrastructure**, and unique ecosystems. Without supporting infrastructure a community's structures may be protected, but the economy and way of life lost. As such, a variety of components will be considered here in terms of management philosophy, potential policy recommendations, and on-the-ground activities.

Communication Infrastructure: This component of the WUI seems to be diversified across the county with multiple source and destination points, and a spread-out support network. To ensure good communication with the USFS, USFWS (CMR) and the BLM resources, radios need to be narrow band and can be placed in "scan mode" to monitor cooperators frequencies. Although site specific treatments will impact local networks directly, little needs done to insure the system's viability.

Transportation Infrastructure (road and rail networks): This component if the WUI has some potential limitations in Petroleum County. The hub of Petroleum County's transportation network is located in Winnett. Specific infrastructure components have been discussed in this plan.

The risk of ignitions along highways are significant and should be address as part of the implementation of this plan. Various alternatives from herbicides to intensive livestock grazing coupled with mechanical treatments, have been suggested. These corridors should be further evaluated with alternatives implemented. A variety of approaches will be appropriate depending on the landowner, fuels present, and other factors. These ignitions are substantial and the potential risk of lives to residents in the area is significant.

Many roads in the county have limiting characteristics, such as narrow travel surfaces, sharp turning radii, low load limit bridges and cattle guards, and heavy accumulations of fuels adjacent to some roads. Some of these road surfaces access remote forestland and rangeland areas. While their improvements will facilitate access in the case of a wildfire, they are not necessarily the priority for treatments in the county.

Roads that have these inferior characteristics and access to homes and businesses are the priority for improvements in the county. Specific recommendations for these roads are enumerated in Table 5.2.

Energy Transport Supply Systems (power lines): (Petroleum County - Appendix I) A number of power lines crisscross Petroleum County. Nearly all of these power lines cross over rangeland ecosystems. When fires ignite in these vegetation types, the fires tend to be fast moving and burn at relatively low intensities. However, there is a potential for high temperatures and low humidity with high winds to produce enough heat and smoke to threaten power line stability. Most power line corridors have been cleared of vegetation both near the wires and from the ground below. It is the recommendation of this Wildfire Mitigation Plan that this situation be evaluated annually and monitored but that treatments not be specifically targeted at this time. The use of these areas as "fire breaks" should be evaluated further, especially in light of the treatments enumerated in this plan (eg., intensive livestock grazing, mechanical treatments, and herbicide treatments).

Water Supply: In some of Montana's communities, water is derived from surface flow that is treated and piped to homes and businesses. When wildfires burn a region, they threaten these watersheds by the removal of vegetation, creation of ash and sediment. As such, watersheds

should be afforded the highest level of protection from catastrophic wildfire impacts. In Petroleum County, water is supplied to homes by single home or multiple home wells.

5.4.1 Proposed Activities

Table 5.3. Infrastructure Enhancements.

Action Item	Goals and Objectives	Responsible Organization	Action Items & Planning Horizon
5.3.a: Post FEMA "Emergency Evacuation Route" signs along the identified Primary and secondary access routes in the county.	**Protection of people and structures** by informing residents and visitors of **significant infrastructure** in the county that will be maintained in the case of an emergency.	**County Commissioners** in cooperation with Rural Fire Districts and Roads Department.	• Purchase of signs (2004). • Posting roads and make information available to residents of the importance of Emergency Routes
5.3.b: Fuels mitigation of the FEMA "Emergency Evacuation Routes" in the county to insure these routes can be maintained in the case of an emergency.	**Protection of people and structures** by providing residents and visitors with ingress and egress that can be maintained during an emergency.	**County Commissioners** in cooperation with Rural Fire Districts and Roads Department.	• Full assessment of road defensibility and ownership participation (2004). • Implementation of projects.

5.5 Resource and Capability Enhancements

There are a number of resource and capability enhancements identified by the rural and wildland fire fighting districts in Petroleum County. All of the needs identified by the districts are in line with increasing the ability to respond to emergencies in the WUI and are fully supported by the planning committee.

Specific reoccurring themes of needed resources and capabilities include:

- Development of water drafting sites in rural locations
- Improved radio capabilities for district communications
- Retention and recruitment of volunteers
- Training and development of rural firefighters in structure and wildland fire
- Up-grade system to retire old fire equipment that does not meet wildfire standards.
- Develop Mutual Aid Agreements with County Wildland Fire organizations and the CMR.

The implementation of each issue will rely on either the isolated efforts of the fire district or a concerted effort by the county to achieve enhancements. Given historic trends, individual departments competing against neighboring departments (in other counties) for grant monies and equipment will not necessarily achieve region wide equity. However, the Snowy Mountain Development Corporation (SMDC) may be an organization uniquely suited to work with all of the districts serving Petroleum County and adjacent counties to assist in the prioritization of needs. Once prioritized, the SMDC is in a position to assist these districts with identifying, competing for, and obtaining grants and equipment to meet these needs.

Table 5.4. WUI Action Items in Fire Fighting Resources and Capabilities.

Action Item	Goals and Objectives	Responsible Organization	Action Items & Planning Horizon
5.4.a: Enhance radio availability in each district, link into existing dispatch, and improve range within the region, update to new digital, narrow band frequency adopted by feds and state. Establish cell tower and communication coverage over the County particularly in Winnett	**Protection of people and structures** by direct fire fighting capability enhancements.	**Rural and Wildland Fire Districts and County Commissioners** in cooperation with Montana Department of Natural Resources and Conservation.	• **Year 1 (2004):** Summarize existing two-way radio capabilities and limitations. Identify costs to upgrade existing equipment and locate funding opportunities. • **Year 2 (2005):** Acquire and install upgrades as needed. • **Year 2-3 (2005-06):** Identify opportunities for radio repeater towers located in the region for multi-county benefits.
5.4.b: Retention of Volunteer Fire Fighters	**Protection of people and structures** by direct fire fighting capability enhancements.	**Rural and Wildland Fire Districts** working with broad base of county citizenry to identify options, determine plan of action, and implement it.	• 5 Year Planning Horizon, extended planning time frame • Target an increased recruitment (+10%) and retention (+20% longevity) of volunteers • **Year 1 (2004):** Develop incentives program and implement it.
5.4.c: Increased training and capabilities of fire fighters	**Protection of people and structures** by direct fire fighting capability enhancements.	**Rural and Wildland Fire Districts** working with the **BLM, DNRC, USFWS, and USFS** for wildland training opportunities and with the **State Fire Marshall's Office** for structural fire fighting training.	• **Year 1 (2004):** Develop a multi-county training schedule that extends 2 or 3 years in advance (continuously). • Identify funding and resources needed to carry out training opportunities and sources to acquire. • Year 1 (2004): Begin implementing training opportunities for volunteers.
5.4.d: Obtain engine with capabilities to draft from unimproved sites for Winnett City Volunteer Fire Department	**Protection of people and structures** by direct fire fighting capability enhancements.	**Winnett Volunteer Fire Department** working with the **BLM, DNRC, USFWS, and USFS.**	• **Year 1 (2004):** Verify stated need still exists, develop budget, and locate funding or equipment. • **Year 1 or 2 (2004-05):** Acquire and deliver needed equipment to districts based on prioritization by need and funding awards.
5.4.e: Acquisition of new fire fighting equipment:	**Protection of people and structures** by direct fire	**Winnett Volunteer Fire Department** working with	• **Year 1 (2004):** Verify stated need still exists,

Table 5.4. WUI Action Items in Fire Fighting Resources and Capabilities.

Action Item	Goals and Objectives	Responsible Organization	Action Items & Planning Horizon
- 5-ton 1,600 gallon 6x6 water tender - Type 6 Wildland Engine (2 trucks) - 5,000 water tender with drafting capabilities and pumps (2 trucks) - Heated Garage for equipment (2 locale) - Permanent water towers for drafting in rural areas. - Implement up-grade equipment program.	fighting capability enhancements. To implement an up-grading system of existing equipment.	the **BLM, DNRC, USFWS, and USFS.**	develop budget, and locate funding or equipment (surplus) sources. • **Year 1 or 2 (2004-05):** Acquire and deliver needed equipment to district based on prioritization by need and funding awards. Retire old equipment and implement up-grade program.

5.6 Regional Land Management Recommendations

In section 5.3 of this plan, reference was given to the role that forestry, grazing and agriculture have in promoting wildfire mitigation services through active management. Petroleum County is dominated by wide expanses of rangelands intermixed with communities and rural houses.

Wildfires will continue to ignite and burn fuels and homes depending on the weather conditions and other factors enumerated earlier. However, active land management that modifies fuels, promotes healthy range and forestland conditions, and promotes the use of these natural resources (consumptive and non-consumptive) will insure that these lands have value to society and the local region. We encourage the Bureau of Land Management, the Montana Department of Natural Resources and Conservation, Charles M. Russell National Wildlife Refuge, Industrial land owners, private land owners, and all other landowners in the region to actively administer their Wildland-Urban Interface lands in a manner consistent with the management of reducing fuels and risks in this zone.

5.6.1 Bureau of Land Management Planned and Potential Treatments

Lewistown Field Office is planning and budgeting for treatments developed after identification and prioritization of treatment areas. Wildland urban interface communities on the Federal Register have received priority planning and treatment. Future projects will usually be identified in the Risk Assessment Mitigation Strategy (RAMS). Project planning and treatment objectives are in accordance with Resource Management Plans and area-specific planning documents.

The following proposed treatments have been provided by the Bureau of Land Management.

5.6.1.1 Proposed Prescribed Fire Projects in the Central Zone Region

Table 5.5 Bureau of Land Management Prescribed Fire Projects in Central Zone region.

Project Name	FMU	Acres*	Current * Condition Class (acres)	Projected * Condition Class 2(acres)	Projected * Condition Class 1 (acres)	Local Contractor
Armells Creek Watershed	Breaks, Monument	12,200	3-6,000 2-6,600	6,000	5,000	N/A
Arrow Creek	Breaks, Monument	5,795	3-2,030 2-3,769	1,500	1,000	N/A
Beaver Creek	Snowies	30	2-30		30	N/A
Becket	Island Ranges	400	3-400	40	350	N/A
BR-12	Prairie Pothole	150	2-150		75	N/A
Driftwood	Prairie Pothole	200	2-200		145	N/A
Gilmore	Big Open, Monument	1,100	2-950		700	N/A
Grass Range	Island Ranges	160	3-50 2-110	15	90	N/A
Havre Breaks	Breaks	30,000	3-5,000 2-20,000 1-5,000	3,000	2,000	N/A
Judith Mountains	Island Ranges	500	3-500	200		N/A
Lincoln Gulch	Island Ranges	30	3-30	20		N/A
Lion Coulee	Big Open, Monument	2,780	3-1,000 2-1,780	550	1,300	N/A
Lonesome Lake	Big Open	13,120	3-700 2-12,420	200	10,000	N/A
Musselshell Breaks	Breaks	5,000	3-2,000 2-3,000	1,000	1,500	N/A
North Moccasins	Island Ranges	300	3-300	200		N/A
North Peterson	Prairie Potholes	200	2-200		75	N/A
Rogers Pass	Front	250	3-250	120		N/A
Upper Missouri	Breaks	10,000	3-6,000 2-4,000	3,500	3,000	N/A

5.6.1.2 Proposed Non-Fire Fuels Treatments in the Central Zone Region

Table 5.6 describes planning and implementation for non-fire treatments. It includes direction for; annual activities for implementation, equipment and seasonal use restrictions, effects monitoring requirements, and reporting, documentation, etc.

Table 5.6 Bureau of Land Management Non-Fire Fuels Treatments in Central Zone Region.

Project Name	FMU	WUI	Acres Treated	By-Product Utilization	Local Contractor	Condition Class 2 moved to 1 (acres)	Condition Class 3 moved to 2 or 1 (acres)	Current Condition Class (acres)
Maiden (JMLA)	Island Ranges	Yes	500	0	Not yet contracted	0	500	3 – 500
North Moccasins (JMLA)	Island Ranges	Yes	80	0	No	0	80	3 – 80
Dog Creek (Arrow Ck EA)	Breaks	No	300	0	No	300	0	2 – 300
Rogers Pass (Rogers Pass CMP and EA)	Front	Yes	250	0	Not yet contracted	130	120	3 – 250

Chapter 6: Supporting Information

6

6.1 List of Tables

6.2 List of Preparers

The following personnel participated in the formulation, compilation, editing, and analysis of alternatives for this assessment.

Table 6.1. List of Preparers

Name	Affiliation	Role
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6.3 Signature Pages

This **Petroleum County Wildland-Urban Interface Wildfire Mitigation Plan** has been developed in cooperation and collaboration with the representatives of the following organizations, agencies, and individuals.

By: Lee Iverson, Chairperson Petroleum County Commissioner	Date
By: Chris King Petroleum County Commissioner	Date
By: Lloyd Rowton Petroleum County Commissioner	Date
By: Clive Rooney Montana Department of Natural Resources and Conservation	Date
By: Mike Stewart USDI BLM	Date
By: Leonard Eickhoff, Chief Winnett Volunteer Fire Department	Date
By: Dave Grantier, Fire Warden Petroleum County	Date

By: Mike Hedrick Charles M. Russell National Wildlife Refuge	Date
By: Kathie Bailey Snowy Mountain Development Corporation	Date
By: William E. Schlosser, Ph.D. Project Manager–Petroleum County WUI Wildfire Mitigation Plan, Lead Author Forester–Northwest Management, Inc.	Date

6.4 Glossary of Terms

Anadromous - Fish species that hatch in fresh water, migrate to the ocean, mature there, and return to fresh water to reproduce (Salmon & Steelhead).

Appropriate Management Response - Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Biological Assessment - Information document prepared by or under the direction of the Federal agency in compliance with U.S. Fish and Wildlife standards. The document analyzes potential effects of the proposed action on listed and proposed threatened and endangered species and proposed critical habitat that may be present in the action area.

Backfiring - When attack is indirect, intentionally setting fire to fuels inside the control line to contain a rapidly spreading fire. Backfiring provides a wide defense perimeter, and may be further employed to change the force of the convection column.

Blackline - Denotes a condition where the fireline has been established by removal of vegetation by burning.

Burning Out - When attack is direct, intentionally setting fire to fuels inside the control line to strengthen the line. Burning out is almost always done by the crew boss as a part of line construction; the control line is considered incomplete unless there is no fuel between the fire and the line.

Canyon Grassland - Ecological community in which the prevailing or characteristic plants are grasses and similar plants extending from the canyon rim to the rivers edge.

Confine - Confinement is the strategy employed in appropriate management responses where a fire perimeter is managed by a combination of direct and indirect actions and use of natural topographic features, fuel, and weather factors.

Contingency Plans: Provides for the timely recognition of approaching critical fire situations and for timely decisions establishing priorities to resolve those situations.

Control Line - An inclusive term for all constructed or natural fire barriers and treated fire edge used to control a fire.

Crew - An organized group of firefighters under the leadership of a crew boss or other designated official.

Crown Fire - A fire that advances from top to top of trees or shrubs more or less independently of the surface fire. Sometimes crown fires are classed as either running or dependent, to distinguish the degree of independence from the surface fire.

Disturbance - An event which affects the successional development of a plant community (examples: fire, insects, windthrow, timber harvest).

Disturbed Grassland - Grassland dominated by noxious weeds and other exotic species. Greater than 30% exotic cover.

Diversity - The relative distribution and abundance of different plant and animal communities and species within an area.

Drainage Order - Systematic ordering of the net work of stream branches, (e.g., each non-branching channel segment is designated a first order stream, streams which only receive first order segments are termed second order streams).

Duff - The partially decomposed organic material of the forest floor beneath the litter of freshly fallen twigs, needles, and leaves.

Ecosystem - An interacting system of interdependent organisms and the physical set of conditions upon which they are dependent and by which they are influenced.

Ecosystem Stability - The ability of the ecosystem to maintain or return to its steady state after an external interference.

Ecotone - The area influenced by the transition between plant communities or between successional stages or vegetative conditions within a plant community.

Energy Release Component - The Energy Release Component is defined as the potential available energy per square foot of flaming fire at the head of the fire and is expressed in units of BTUs per square foot.

Equivalent Clearcut Area (ECA) - An indicator of watershed condition, which is calculated from the total amount of crown removal that has occurred from harvesting, road building, and other activities based on the current state of vegetative recovery.

Exotic Plant Species - Plant species that are introduced and not native to the area.

Fire Adapted Ecosystem - An arrangement of populations that have made long-term genetic changes in response to the presence of fire in the environment.

Fire Behavior - The manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire Behavior Forecast - Fire behavior predictions prepared for each shift by a fire behavior analysis to meet planning needs of fire overhead organization. The forecast interprets fire calculations made, describes expected fire behavior by areas of the fire, with special emphasis on personnel safety, and identifies hazards due to fire for ground and aircraft activities.

Fire Behavior Prediction Model - A set of mathematical equations that can be used to predict certain aspects of fire behavior when provided with an assessment of fuel and environmental conditions.

Fire Danger - A general term used to express an assessment of fixed and variable factors such as fire risk, fuels, weather, and topography which influence whether fires will start, spread, and do damage; also the degree of control difficulty to be expected.

Fire Ecology - The scientific study of fire's effects on the environment, the interrelationships of plants, and the animals that live in such habitats.

Fire Exclusion - The disruption of a characteristic pattern of fire intensity and occurrence (primarily through fire suppression).

Fire Intensity Level - The rate of heat release (BTU/second) per unit of fire front. Four foot flame lengths or less are generally associated with low intensity burns and four to six foot flame lengths generally correspond to "moderate" intensity fire effects. High intensity flame lengths are usually greater than eight feet and pose multiple control problems.

Fire Prone Landscapes – The expression of an area's propensity to burn in a wildfire based on common denominators such as plant cover type, canopy closure, aspect, slope, road density, stream density, wind patterns, position on the hillside, and other factors.

Fireline - A loose term for any cleared strip used in control of a fire. That portion of a control line from which flammable materials have been removed by scraping or digging down to the mineral soil.

Fire Management - The integration of fire protection, prescribed fire and fire ecology into land use planning, administration, decision making, and other land management activities.

Fire Management Plan (FMP) - A strategic plan that defines a program to manage wildland and prescribed fires and documents the fire management program in the approved land use plan. This plan is supplemented by operational procedures such as preparedness, preplanned dispatch, burn plans, and prevention. The fire implementation schedule that documents the fire management program in the approved forest plan alternative.

Fire Management Unit (FMU) - Any land management area definable by objectives, topographic features, access, values-to-be-protected, political boundaries, fuel types, or major fire regimes, etc., that set it apart from management characteristics of an adjacent unit. FMU's are delineated in FMP's. These units may have dominant management objectives and preselected strategies assigned to accomplish these objectives.

Fire Occurrence - The number of wildland fires started in a given area over a given period of time. (Usually expressed as number per million acres.)

Fire Prevention - An active program in conjunction with other agencies to protect human life, prevent modification, of the ecosystem by human-caused wildfires, and prevent damage to cultural resources or physical facilities. Activities directed at reducing fire occurrence, including public education, law enforcement, personal contact, and reduction of fire risks and hazards.

Fire Regime - The fire pattern across the landscape, characterized by occurrence interval and relative intensity. Fire regimes result from a unique combination of climate and vegetation. Fire regimes exist on a continuum from short-interval, low-intensity (stand maintenance) fires to long-interval, high-intensity (stand replacement) fires.

Fire Retardant - Any substance that by chemical or physical action reduces flareability of combustibles.

Fire Return Interval - The number of years between two successive fires documented in a designated area.

Fire Risk - The potential that a wildfire will start and spread rapidly as determined by the presence and activities of causative agents.

Fire Severity - The effects of fire on resources displayed in terms of benefit or loss.

Foothills Grassland - Grass and forb co-dominated dry meadows and ridges. Principle habitat type series: bluebunch wheatgrass and Idaho fescue.

Fuel - The materials which are burned in a fire; duff, litter, grass, dead branchwood, snags, logs, etc.

Fuel Break - A natural or manmade change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled.

Fuel Loading - Amount of dead fuel present on a particular site at a given time; the percentage of it available for combustion changes with the season.

Fuel Model - Characterization of the different types of wildland fuels (trees, brush, grass, etc.) and their arrangement, used to predict fire behavior.

Fuel Type - An identifiable association of fuel elements of distinctive species; form, size, arrangement, or other characteristics, that will cause a predictable rate of fire spread or difficulty of control, under specified weather conditions.

Fuels Management - Manipulation or reduction of fuels to meet protection and management objectives, while preserving and enhancing environmental quality.

Gap Analysis Program (GAP) - Regional assessments of the conservation status of native vertebrate species and natural land cover types and to facilitate the application of this information to land management activities. This is accomplished through the following five objectives:

1. Map the land cover of the United States
2. Map predicted distributions of vertebrate species for the U.S.
3. Document the representation of vertebrate species and land cover types in areas managed for the long-term maintenance of biodiversity
4. Provide this information to the public and those entities charged with land use research, policy, planning, and management
5. Build institutional cooperation in the application of this information to state and regional management activities

Habitat - A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Heavy Fuels - Fuels of a large diameter, such as snags, logs, and large limbwood, which ignite and are consumed more slowly than flash fuels.

Hydrologic Unit Code - A coding system developed by the U. S. Geological Service to identify geographic boundaries of watersheds of various sizes.

Hydrophobic - Resistance to wetting exhibited by some soils, also called water repellency. The phenomena may occur naturally or may be fire-induced. It may be determined by water drop penetration time, equilibrium liquid-contact angles, solid-air surface tension indices, or the characterization of dynamic wetting angles during infiltration.

Human-Caused Fires - Refers to fires ignited accidentally (from campfires or smoking) and by arsonists; does not include fires ignited intentionally by fire management personnel to fulfill approved, documented management objectives (prescribed fires).

Intensity - The rate of heat energy released during combustion per unit length of fire edge.

Inversion - Atmospheric condition in which temperature increases with altitude.

Ladder Fuels - Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

Landsat Imagery - Land remote sensing, the collection of data which can be processed into imagery of surface features of the Earth from an unclassified satellite or satellites.

Landscape - All the natural features such as grasslands, hills, forest, and water, which distinguish one part of the earth's surface from another part; usually that portion of land which the eye can comprehend in a single view, including all its natural characteristics.

Lethal - Relating to or causing death; extremely harmful.

Lethal Fires - A descriptor of fire response and effect in forested ecosystems of high-severity or severe fire that burns through the overstory and understory. These fires typically consume large woody surface fuels and may consume the entire duff layer, essentially destroying the stand.

Litter - The top layer of the forest floor composed of loose debris, including dead sticks, branches, twigs, and recently fallen leaves or needles, little altered in structure by decomposition.

Maximum Manageable Area - The boundary beyond which fire spread is completely unacceptable.

Metavolcanic - Volcanic rock that has undergone changes due to pressure and temperature.

Minimum Impact Suppression Strategy (MIST) - "Light on the Land." Use of minimum amount of forces necessary to effectively achieve the fire management protection objectives consistent with land and resource management objectives. It implies a greater sensitivity to the impacts of suppression tactics and their long-term effects when determining how to implement an appropriate suppression response.

Mitigation - Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

Monitoring Team - Two or more individuals sent to a fire to observe, measure, and report its behavior, its effect on resources, and its adherence to or deviation from its prescription.

National Environmental Policy Act (NEPA) - This act declared a national policy to encourage productive and enjoyable harmony between humans and their environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and will stimulate the health and welfare of humankind; to enrich the understanding of important ecological systems and natural resources; and to establish a Council on Environmental Quality.

National Fire Management Analysis System (NFMAS) - The fire management analysis process, which provides input to forest planning and forest and regional fire program development and budgeting.

Native - Indigenous; living naturally within a given area.

Natural Ignition - A wildland fire ignited by a natural event such as lightning or volcanoes.

Noncommercial Thinning - Thinning by fire or mechanical methods of precommercial or commercial size timber, without recovering value, to meet MFP standards relating to the protection/enhancement of adjacent forest or other resource values.

Notice of Availability - A notice of Availability published in the Federal Register stating that an EIS has been prepared and is available for review and comment (for draft) and identifying where copies are available.

Notice of Intent - A notice of Intent published in the Federal Register stating that an EIS will be prepared and considered. This notice will describe the proposed action and possible alternatives, the proposed scoping process, and the name and address of whom to contact concerning questions about the proposed action and EIS.

Noxious Weeds - Rapidly spreading plants that have been designated "noxious" by law which can cause a variety of major ecological impacts to both agricultural and wild lands.

Planned Ignition - A wildland fire ignited by management actions to meet specific objectives.

Prescribed Fire - Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

Prescription - A set of measurable criteria that guides the selection of appropriate management strategies and actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations.

Programmatic Biological Assessment - Assesses the effects of the fire management programs on Federally listed species, not the individual projects that are implemented under these programs. A determination of effect on listed species is made for the programs, which is a valid assessment of the potential effects of the projects completed under these programs, if the projects are consistent with the design criteria and monitoring and reporting requirement contained in the project description and summaries.

Reburn - Subsequent burning of an area in which fire has previously burned but has left flareable light that ignites when burning conditions are more favorable.

Riparian Habitat Conservation Areas (RHCA) - Portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. RHCAs include traditional riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the stream's water, sediment, woody debris, and nutrient delivery systems.

Riparian Management Objectives (RMO) - Quantifiable measures of stream and streamside conditions that define good fish habitat and serve as indicators against which attainment or progress toward attainment of goals will be measured.

Road Density - The volume of roads in a given area (mile/square mile).

Scoping - Identifying at an early stage the significant environmental issues deserving of study and de-emphasizing insignificant issues, narrowing the scope of the environmental analysis accordingly.

Seral - Refers to the stages that plant communities go through during succession. Developmental stages have characteristic structure and plant species composition.

Serotinous - Storage of coniferous seeds in closed cones in the canopy of the tree. Serotinous cones of lodgepole pine do not open until subjected to temperatures of 113 to 122 degrees Fahrenheit causing the melting of the resin bond that seals the cone scales.

Stand Replacing Fire - A fire that kills most or all of a stand.

Sub-basin - A drainage area of approximately 800,000 to 1,000,000 acres, equivalent to a 4th - field Hydrologic Unit Code.

Surface Fire - Fire which moves through duff, litter, woody dead and down, and standing shrubs, as opposed to a crown fire.

Watershed - The region draining into a river, river system, or body of water.

Wetline - Denotes a condition where the fireline has been established by wetting down the vegetation.

Wildland Fire - Any nonstructure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Implementation Plan (WFIP) - A progressively developed assessment and operational management plan that documents the analysis and selection of strategies and describes the appropriate management response for a wildland fire being managed for resource benefits. A full WFIP consists of three stages. Different levels of completion may occur for differing management strategies (i.e., fires managed for resource benefits will have two-three stages of the WFIP completed while some fires that receive a suppression response may only have a portion of Stage I completed).

Wildland Fire Situation Analysis (WFSA) - A decision making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives.

Wildland Fire Use - The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outlined in FMP's. Operational management is described in the WFIP. Wildland fire use is not to be confused with "fire use", which is a broader term encompassing more than just wildland fires.

Wildland Fire Use for Resource Benefit (WFURB) - A wildland fire ignited by a natural process (lightning), under specific conditions, relating to an acceptable range of fire behavior and managed to achieve specific resource objectives.

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